# POWER TRANSMISSION DESIGN

OCTOBER 1960

MACHINE DRIVES & COMPONENTS

STEVENS RICE
UNIVERSITY MICROFILMS INC
313 N FIRST ST
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## BEARING MOUNTING DESIGN

ALSO IN THIS ISSUE:

- The F-106 Constant-Speed Generator Drive
- Disks Keep Shift Time Constant In Transmission Synchronizer

FRANCHISE CIRCULATION
DISTILLED WRITING

INCLUDING BEARINGS DESIGN / APPLICATION

**Read by 40,000 men who specify power transmission products for original equipment and in-plant applications**

# Aetna BEARINGS

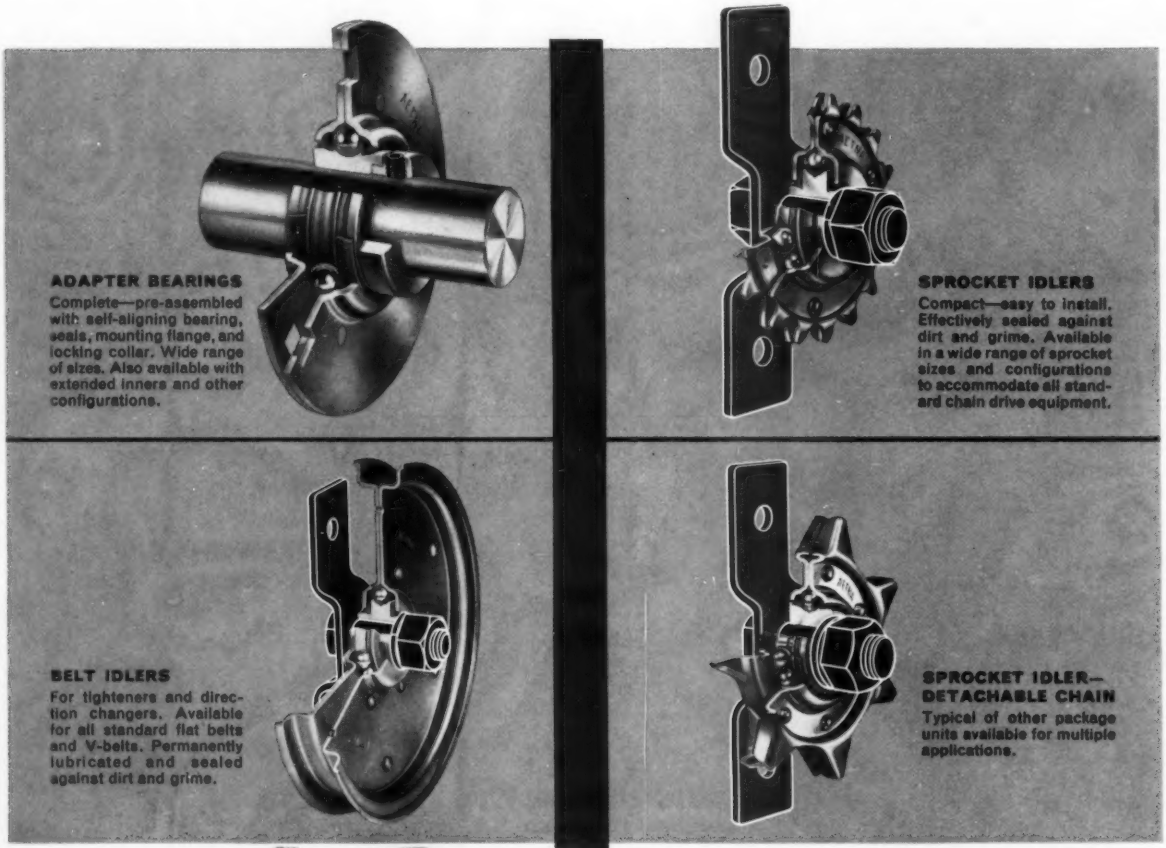
*Aetna Packaged Bearing Units*

## REDUCE COSTS...

## STEP UP PRODUCTION

Low-cost Aetna packaged bearing units simplify modern assembly line production. Designed as complete, integral, prelubricated units, these bearings greatly reduce over-all assembly costs and assembly time, and minimize stock handling. Individual units are simple in design, incorporating a single row of radial ball bearings with extra large lubricant capacity and a highly efficient seal. For all light-duty, medium speed applications, they assure dependable product performance free from troublesome servicing.

For complete information, call your Aetna representative listed in your telephone directory, or write for Prelubricated Bearing Catalog AG-59.

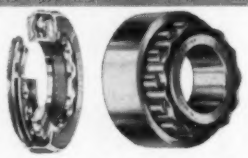


**ADAPTER BEARINGS**
Complete—pre-assembled with self-aligning bearing, seals, mounting flange, and locking collar. Wide range of sizes. Also available with extended inners and other configurations.

**SPROCKET IDLERS**
Compact—easy to install. Effectively sealed against dirt and grime. Available in a wide range of sprocket sizes and configurations to accommodate all standard chain drive equipment.

**BELT IDLERS**
For tighteners and direction changers. Available for all standard flat belts and V-belts. Permanently lubricated and sealed against dirt and grime.

**SPROCKET IDLER—DETACHABLE CHAIN**
Typical of other package units available for multiple applications.



**AETNA BALL AND ROLLER BEARING COMPANY**
DIVISION OF PARKERSBURG-AETNA CORPORATION

4600 SCHUBERT AVE.
CHICAGO 39, ILL.

ANTI-FRICTION SUPPLIERS TO LEADING ORIGINAL EQUIPMENT MANUFACTURERS SINCE 1916

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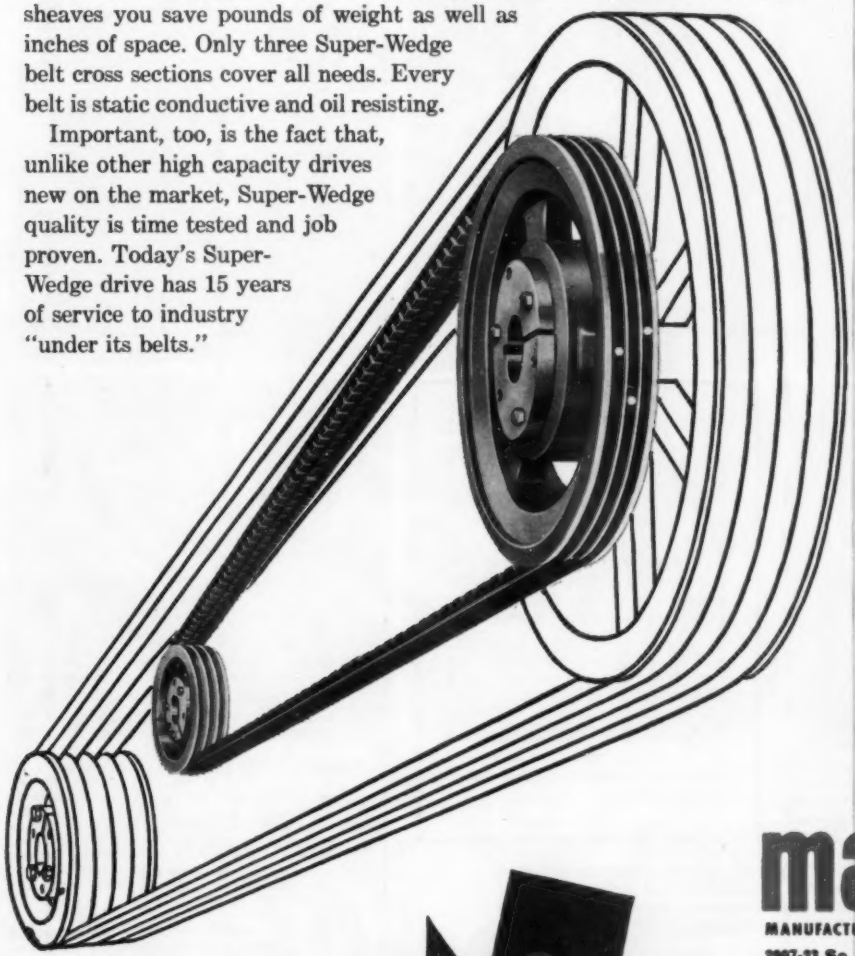
# maurey

## *Super-Wedge V-Drives*

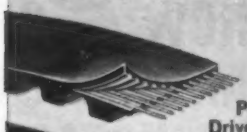
**GET BIG DRIVE CAPACITY**
**INTO SMALL DRIVE SPACE**
**AND WHIP THE COST, TOO!**

When your drive problem is to cut down the space and keep up the power, Super-Wedge is for you. Super-Wedge belts and sheaves are smaller and lighter, centers are shorter, cost is less, and the power capacity is all there. Narrow, limber Super-Wedge belts have tremendous load carrying strength. Controlled stretch keeps them perfectly matched. Their deep side walls contact fully with the narrow grooves of Super-Wedge sheaves to pull with extra power. With narrow, small diameter Super-Wedge sheaves you save pounds of weight as well as inches of space. Only three Super-Wedge belt cross sections cover all needs. Every belt is static conductive and oil resisting.

Important, too, is the fact that, unlike other high capacity drives new on the market, Super-Wedge quality is time tested and job proven. Today's Super-Wedge drive has 15 years of service to industry "under its belts."



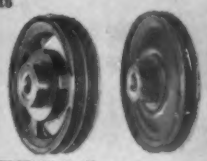
*get more* **drive**
*with Maurey drives*



Positive Drive Belts

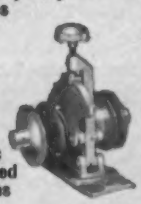
Variable Speed Belts

Mor-Grip V-Belts



Hi-Q FHP V-Pulleys

Complete heavy duty V-Belt Drives



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Roller Chains

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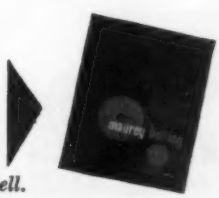

**CATALOG B-60 GIVES DETAILS**
*not only on the Super-Wedge Drive,*
*but on other proven Maurey quality drives as well.*
**WRITE FOR YOUR FREE COPY**

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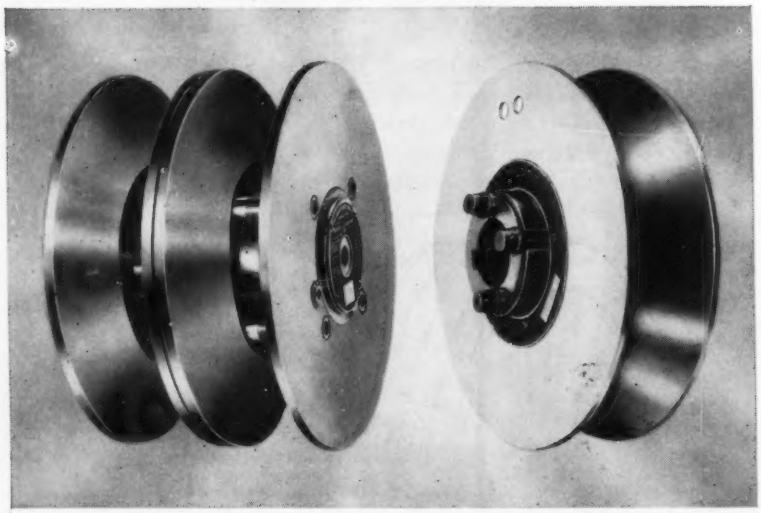
# NOW AP OFFERS THE MOST COMPLETE LINE OF WIDE-RANGE ADJUSTABLE-SPEED DRIVES FROM STOCK



Single groove drives in "Q", "R", and "W" cross-section transmit up to 20 hp.
Double groove drives in "R" cross-section transmit up to 30 hp.

Order from 7 sizes and 4 models of AP Wide-Range Adjustable-Speed Drives. Single groove drives in "Q", "R", and "W" belt cross-section width transmit up to 20 hp. And double-groove drives in "R" belt cross-section widths deliver up to 30 hp.

Previously made on special order for textile machinery manufacturers, AP 2-R Groove Adjustable-Speed Drives are now being made for Stock. Intended for use on machines where a heavy duty, dependable, economical adjustable-speed drive is needed, they are ideal for replacement of existing overloaded drives—and new installations—where increased capacities are required.

AP Wide-Range Adjustable-Speed Drives are the economical, compact and positive form of speed control. Furnishing quiet, accurate adjustment (up to 2:1), they insure proper drive speed for all applications.

**FEATURES:**

1 Exclusive double-tapered hub locks flanges securely—permits stepless, accurate speed adjustment. Small or large adjustments are precise and permanent, no freezing.

2 Precisely machined and dynamically balanced, all sheaves are strong, quiet running, long-lasting and trouble-free.

3 Simultaneously moving flanges insure correct belt alignment at all times.

4 Companion Sheaves feature Q-D Bushings. Easily installed or removed, they grip shaft firmly.

*Your* AP *Distributor will tell you why more mill men are specifying* AP *Adjustable-Speed Drives. See him! His experience and engineering know-how will prove that it pays for you to standardize on* AP.

THE AMERICAN PULLEY COMPANY
4200 WISSAHICKON AVENUE • PHILADELPHIA 29, PA.
*A division of VAN NORMAN INDUSTRIES INC.*

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THERE'S POSITIVELY
NOTHING LIKE NEW GOODYEAR

positive drive

# BELTS

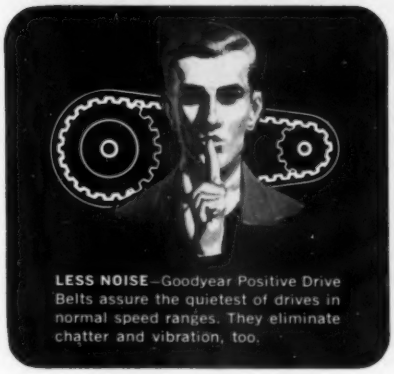
## —for positive assurance of quality in maximum-efficiency belts

*With Goodyear quality Positive Drive Belts now at your disposal, you're free to explore all these new avenues in machine or appliance design—*

**SMALLER SIZE**—With Goodyear Positive Drive Belts, you can use smaller pulleys — shorter centers — narrower belts of higher capacities. Center distance can be permanently established.

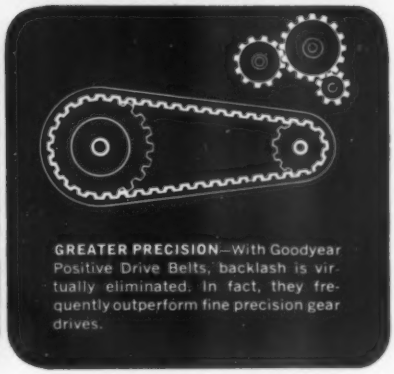
**LIGHTER WEIGHT** — With their high horsepower-to-weight ratio, Goodyear Positive Drive Belts are ideal for portable tools, machines and aircraft assemblies. Pulleys can be light plastics or alloys.

**LIGHTER BEARINGS** — Since the use of Goodyear Positive Drive Belts makes high tension no longer necessary, bearing loads are much less. Some bearings as well as adjustable motor bases and idlers may be eliminated entirely.



**LESS NOISE**—Goodyear Positive Drive Belts assure the quietest of drives in normal speed ranges. They eliminate chatter and vibration, too.

**SIMPLIFIED MAINTENANCE** — Since Goodyear Positive Drive Belts involve no metal-to-metal contact, no lubricating systems, oil-retaining devices, etc., are necessary. That bars possible product contamination, too.



**GREATER PRECISION**—With Goodyear Positive Drive Belts, backlash is virtually eliminated. In fact, they frequently outperform fine precision gear drives.

And remember — Positive Drive Belts are designed and built to the famed Goodyear high standards of quality. For full details on belts for drives from fractional to 600 H.P.—for speeds up to 16,000 f.p.m., contact the G.T.M. — Goodyear Technical Man. He's available through your Goodyear Distributor — or by writing Goodyear, Industrial Products Division, Lincoln 2, Nebraska, or Akron 16, Ohio.

Goodyear Positive Drive Belts are manufactured under license and according to U. S. Patents 2,507,852 and 2,397,312.

POSITIVE DRIVE BELTS BY

# GOODYEAR

THE GREATEST NAME IN RUBBER

Circle No. 28 on Reader Service Card

OCTOBER 1960

volume 2 number 10

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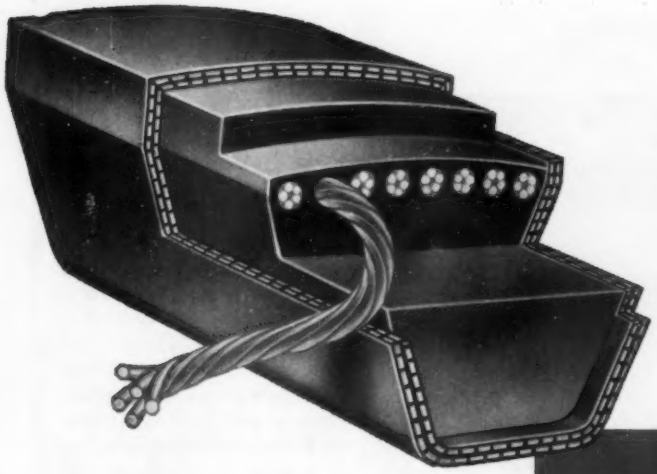
***Before going further, tear out a Reader Service Card which you will find bound into this issue. Fill it out as you read and mail it when you're done. We'll act on your request immediately.***

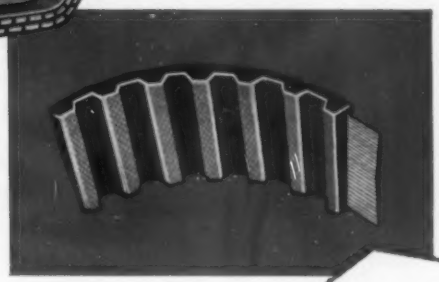


*Need High Capacity In Compact Space?*

DA 358 V-BELTS. This major design improvement in V-Belts brings you unprecedented compactness, high capacity and drive economy.

*Chain and Gear Benefits with No Metal-to-Metal Contact?*

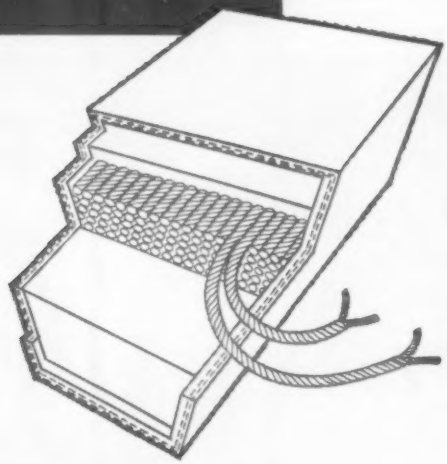
DA POSITIVE DRIVE BELTS. Revolutionary tooth-grip principle; no stretch; no constant lubrication. Highly versatile.



# *Whatever your V-Belt needs,* DURKEE-ATWOOD *meets them*

What do you want in a V-Belt? You want consistent performance, long trouble-free life and full-rated power transmission. That means the belts must be made of the finest quality materials, with careful attention to engineering details, manufacturing processes and testing procedures. Durkee-Atwood V-Belts are made of the newest high tenacity synthetic fibres to assure length stability in storage. The exclusive Durkee-Atwood "Iso-Dynamic" Vertical Matching Machine eliminates the "sag error" that develops when V-Belts are matched on horizontal equipment. This assures equal power transmission from all belts on multiple drives . . . Look to Durkee-Atwood for *quality, service* and *savings ...the most complete line of industrial V-Belts.*

*Look for the* DA *On Your V-Belts*



*40% Extra Capacity in Regular V-Belts?*

RED SHIELD MULTIPLE V-BELTS. Increased capacity at no increased cost. Available in oil and heat resistant and static dissipating constructions.

*Top Performance in Variable Speed Drives?*

VARIABLE SPEED BELTS. For constant performance. Abrasion-resistant cover; crowned cross section maintains stability under extreme loads.

## DURKEE-ATWOOD V-BELTS

DURKEE-ATWOOD COMPANY MINNEAPOLIS 13, MINNESOTA

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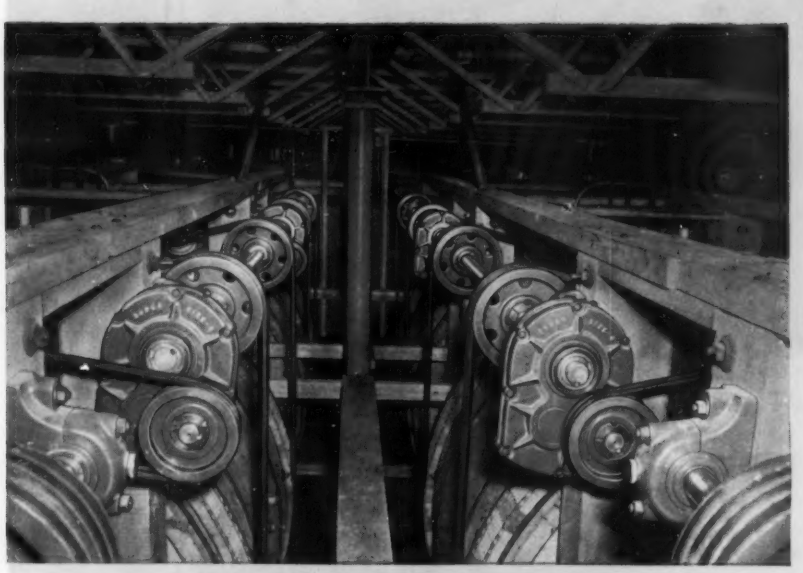
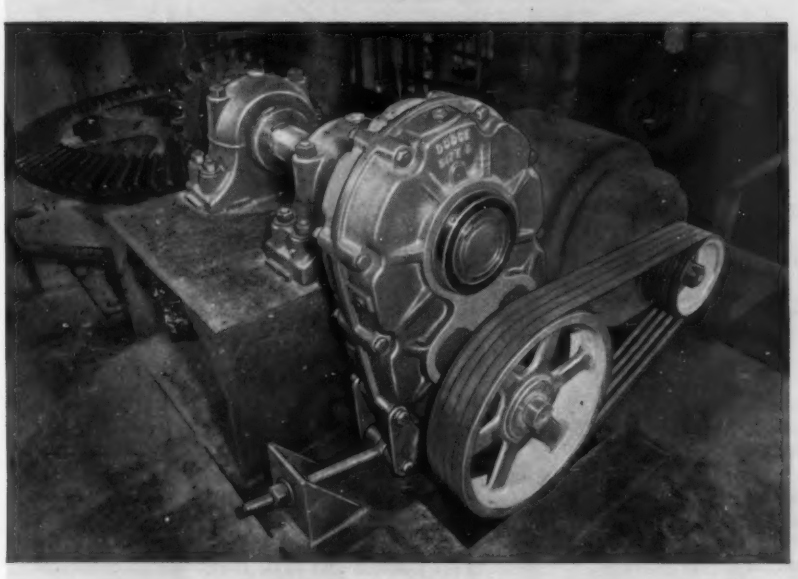


**DODGE TORQUE-ARM SHAFT MOUNTED SPEED REDUCER**

Install it anywhere—with minimum time and effort. Here is an overhead installation on tanning drums. Torque-Arm reducers are resistant to acid fumes, salt water environment, moisture.



**DODGE TORQUE-ARM SHAFT MOUNTED SPEED REDUCER**

Can be positioned any place on the entire length of the shaft. It locks into place on *both* sides of the housing. Note modified torque arm on this installation on a mixer in a beverage plant.

# The Speed Reducer Idea that

Two things account for the record popularity of Dodge Torque-Arm Speed Reducers. First, they cost less to install since they require no foundations, sliding motor rails or flexible couplings. Second—and most important—these modern reducers as developed by Dodge perform *brilliantly*. Tens of thousands of installations underscore Torque-Arm dependability. Torque-Arm is America's *quality* shaft mounted speed reducer!

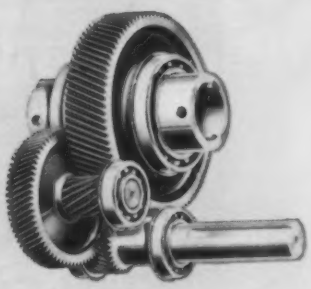
Torque-Arm has been so extensively adopted by industry that today models are available for a vast range of applications. The Torque-Arm line offers you capacities up to 170 hp—output speeds from 10 to 400 rpm—in single and double reduction series—with 5 to 1, 15 to 1 and 25 to 1 ratios. Models for vertical or inclined shaft operation are available—as well as special-application versions such as flange mounted, right

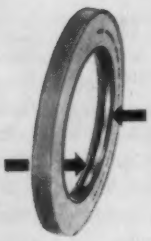
## Rugged semisteel housing— a solid backbone for solid service

Here is a tough, corrosion-resistant housing with the strength to hold bearing seats in line for the life of the unit. Perfect shaft and gear alignment are assured by doweling the matched halves together and boring in line. No gear is overhung. Loads are carried easily, contributing to Torque-Arm's long life and high efficiency—97% in double reduction models, almost 99% in single!

## AGMA rated gears— quality-guarded by continual tests

These helical gears have soft cores to withstand shock—and hardened surfaces to resist wear. Their quality is guarded in manufacture and assembly by the most modern methods of quality control, including inspection for runout, tooth spacing, helical lead and involute profile. They run quietly, mesh precisely. Teeth are crown shaved for maximum contact area. Gears are shrunk on their shafts to prevent shifting.





## Modern double-lip seals keep oil in and dirt out

Modern synthetic, double-lip seals of the highest quality keep oil in and dirt out of the reducer case. These seals offer protection for the unit from dust and dirt and just as effectively insure cleanliness when operating in laundries, textile mills, food processing plants.

# Re-ally Clicked!

angle and extended input shaft styles. Optional equipment includes a positive, sealed-in backstop and a positive overload release.

Ask your local Dodge Distributor. Or write us for our 64-page Torque-Arm Speed Reducer Bulletin, complete with engineering data and easy selection tables.

DODGE MANUFACTURING CORPORATION
8200 Union Street • Mishawaka, Indiana

**DODGE**
of Mishawaka, Ind.

**CALL THE TRANSMISSIONEER**—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

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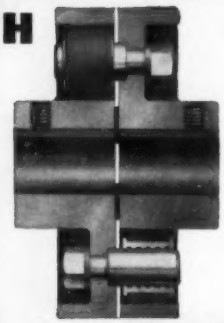
**DYNAMOMETER TESTING TIME SAVED WITH AJAX FLEXIBLE COUPLINGS**



Cross Section of AJAX Rubber-Cushioned, Sleeve Bearing Coupling.

Hours are saved by one of America's foremost motor manufacturers because of the quick hook-up made possible by AJAX Flexible Couplings. Their quick connect and disconnect provides practically instant engagement and disengagement between motors and dynamometers.

AJAX Rubber-Cushioned, Sleeve Bearing design also saves line-up time and eliminates end-float problems. Motors being tested range from 40 to 150 HP.

Write for complete information on AJAX Rubber-Cushioned and Dihedral Gear Type Couplings.

AJAX

**AJAX FLEXIBLE COUPLING CO. INC.**

132 Portage Road Westfield, N. Y.

*Representatives in Principal Cities*

IN CANADA — The Alexander Fleck Ltd., Ottawa

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# LETTERS

Address letters to:
The Editor
Power Transmission Design
812 Huron Road, Cleveland 15, Ohio

## We slipped . . .

As producers of over two million torque converters in the last ten years, we felt slighted at being excluded from your directory of torque converter manufacturers which appeared in the August issue of POWER TRANSMISSION DESIGN.

We make 11-¾, 12, and 12-5/16-in. diam converters for industrial applications. Stall torque ratios are from 2.00 to 2.54:1. Maximum torque capacities are up to 275 lb-ft. Efficiencies are as high as 90% during converter phase operation and approach 97% in the fluid coupling phase.

In general this article was very well written and should help to acquaint more designers with this type of drive. We hope it will stimulate future torque converter applications. I'd like, also, to take this opportunity to thank you for being on the POWER TRANSMISSION DESIGN circulation list.

M. J. WACLAWEK
Chief Project Engineer
Borg & Beck, Div., Borg-Warner Corp.
Chicago, Ill.

*In gathering information for a comprehensive article like this, these unintentional omissions do occasionally occur. We hope that publication of your letter will make at least partial amends.*

## Nomogram request

Gentlemen:

Could you publish a nomogram showing the gallonage per minute of a hydraulic pump at a given speed for different cu in. per minute displacements? E.g.: A pump delivers 6 GPM at 3600 RPM. What's its displacement per rev?

MR. LANDANCE
Port Machine Shop
1912 Chapin Street
Tampa 5, Florida

*A nomogram that does this appeared in our May 1960 issue, page 54. Incidentally, this works with hydraulic motors, too.*

# 10 good reasons for choosing Dynamatic Eddy-Current Speed Control Equipment

1 Adjustable speed from AC power

2 Accurate speed control

3 Wide speed range

4 Rapid response

5 Low power loss

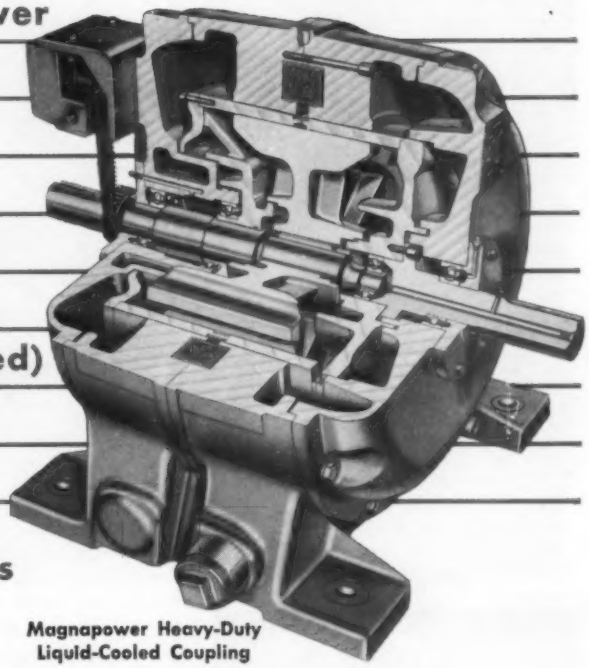
6 Simplified construction

7 Remote control (when desired)

8 Quiet, efficient operation

9 Low maintenance cost

10 No commutators, rings, brushes, or rotating coils



Magnapower Heavy-Duty Liquid-Cooled Coupling

Using standard alternating current as a power source, Dynamatic Eddy-Current Couplings and Drives are the answer to practically all stepless adjustable speed requirements.

A wide range of standard and special control features may be obtained from electronic or transistorized magnetic amplifier control systems. The addition of an eddy-current brake to standard couplings or drives provides smooth, cushioned stops and controlled deceleration.

Dynamatic Eddy-Current Equipment is available in sizes from ¼ hp Ajusto-Spede Drives to heavy-duty Magnapower Couplings rated up to 20,000 hp—and larger.

Place your speed control problems in the hands of experts. Our representatives, located in all principal cities, are fully qualified to discuss your speed control problems and suggest Dynamatic Equipment that will do the best job for you. Call Dynamatic today—there is no obligation.

EATON

DYNAMATIC®

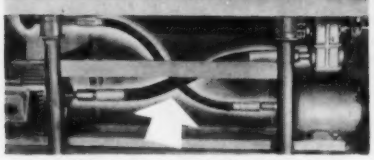
**ORIGINATOR AND LEADING PRODUCER OF EDDY-CURRENT SPEED CONTROL EQUIPMENT**

*May we Send You Illustrated Literature Describing Dynamatic Eddy-Current Equipment*

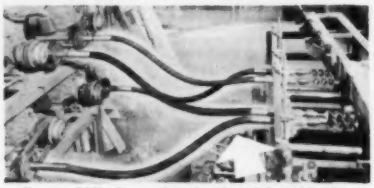
**EATON** MANUFACTURING COMPANY
DYNAMATIC DIVISION
3122 FOURTEENTH AVENUE • KENOSHA, WISCONSIN

Circle No. 22 on Reader Service Card

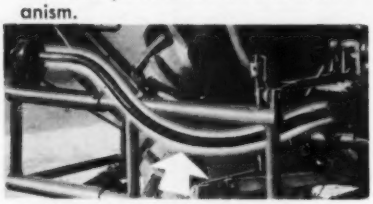
Here's how *Elliott*
**Flexible Shafts are Saving TIME and MONEY**



Two Elliott Standard Flexible Shafts drive special processing machine and vibrator operating simultaneously. Flexible Shafts isolate vibration of table from motors.



Four ¾" Standard Flexible Shafts used in special production machinery in box manufacturing company eliminate parts and intricate mechanism.



Safety is enhanced, appearance improved by coupling bale loader to tractor's power take-off with a Standard Flexible Shaft. Separate gas engine for loader is eliminated.

One Elliott Flexible Shaft assembly can replace many parts, saving assembly time and labor. In one application, a Flexible Shaft for a textile machine replaced 50 parts, reduced cost of original mechanism by two-thirds.

Write for our Catalog **263**

'FLEXIBLE SHAFT DATA FOR DESIGNERS'

**B.W. ELLIOTT MFG. CO., INC.**
251 State St., Binghamton, N. Y.

Circle No. 23 on Reader Service Card

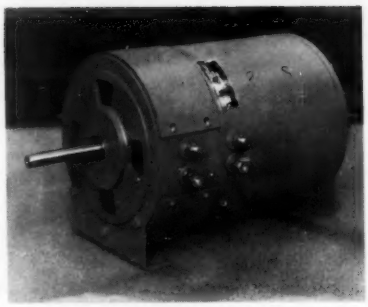
# NEWS *from the power transmission field*

## Modified traction motor drives electric automobile

SCHENECTADY, N. Y.—A single nine-inch diameter, 72v traction motor from General Electric is used to drive the Eureka Williams' "Henney Kilowatt", a new electric automobile demonstrated recently at a meeting of the Edison Electric Institute at Atlantic City.

The Kilowatt uses a Renault Dauphine body, weighs about 2245 lbs, with an 89 in. wheelbase. Range varies from 40 miles a day continuous running to 50 to 60 miles a day with frequent stops. Top speed is 35 mph fully loaded.

The motor, from General Electric's Direct Current and Generator Dept., is basically an electric truck motor, modified to produce high torque per ampere with reduced weight and size. The design features special adapters and shaft configurations. Speed is changed by adjustment of the armature voltage, principally by series and paralleling the batteries. This is done by a magnetic control worked by a foot pedal similar to the gas pedal in a conventional car. You reverse by flipping a switch on the dashboard. Maintenance consists of keeping the batteries filled and lubricating nine chassis grease fittings. Batteries can be recharged overnight by plugging into any 110 or 220 vac outlet, since rechargers are standard on production models. A power take-off can be provided



for driving accessories.

Engineered by the Henney Motor Co. Div. of Eureka Williams, the Kilowatt is the combined inspiration of B. L. England, board chairman of Atlantic City Electric Co., and G. Russel Feldman, president of Eureka Williams. Sales are at present limited to the utility industry.

## SKF opens staff services to distributors

PHILADELPHIA, PA.—Under a new plan recently announced, authorized distributors of SKF bearings will be able to call on the firm's staff specialists for expert business advice. Called the Trade Aid Plan, the services offered will range from insurance and taxes to how recruit personnel. Main beneficiaries will be smaller businesses.

# NEW Dick SUPLEX oil, grease-defying BELTING

***WITH EXCELLENT MECHANICAL EFFICIENCY UNDER ADVERSE CONDITIONS***

**ANOTHER MAJOR DEVELOPMENT FROM R. & J. DICK —**
Suplex Belting has already proved a profitable find in industry after industry. With it there's no slippage or stretch in the presence of grease and oil. Loss of drive efficiency due to oily conditions, machine shutdown for belting maintenance, excessive wear on belting—all have been eliminated.

**A STRONG, DURABLE, ALL-SYNTHETIC BELTING**
Suplex Belting is a special, oil resistant version of our revolutionary Dixylon Belting and offers all the advantages of Dixylon: its great strength, durability, freedom from stretch . . . will run for years without take-up . . . can be used on small pulley diameters at amazingly high speeds. Available in fractional H.P. up to one thousand H.P.

Versatile, easily fitted to the drive . . . joined on the job . . . smooth, strong joints . . . made endless in minutes with simple tools.

Get All The Facts About Suplex Belting Now. Send Coupon For Catalog.

*Clip and Mail*

R. & J. Dick Company, Inc.
Dept. 10-J, Totowa, New Jersey
Without obligation to me, please send catalog on Suplex Oil-Resistant Belting.

Name_____
Position_____
Company_____
Full Address_____
_____

*R. & J.* Dick *company inc.*
TOTOWA, NEW JERSEY • CLifford 6-6400
*Design Leadership*
CHICAGO • LOS ANGELES • SAN FRANCISCO • SEATTLE

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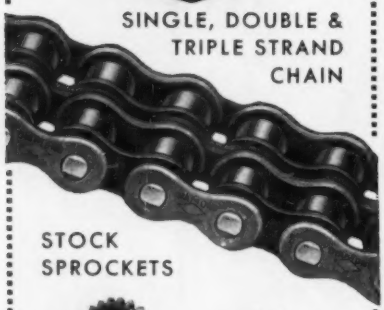
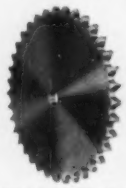
for power transmission

DIAMOND
Roller Chain & Sprockets

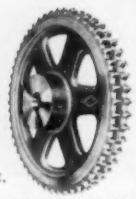
SINGLE, DOUBLE & TRIPLE STRAND CHAIN



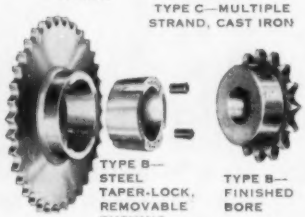
STOCK SPROCKETS



TYPE A—STEEL PLATE, NO HUB



TYPE C—MULTIPLE STRAND, CAST IRON



TYPE B—STEEL TAPER-LOCK, REMOVABLE BUSHING

TYPE B—FINISHED BORE

◆ It's sound engineering to use stock DIAMOND Roller Chain for efficient drives, even on the most highly specialized machinery. Standard DIAMOND Roller Chain and stock Sprockets shorten development time, cut power transmission design costs, lower production costs. For power transfer, precision timing, conveying—whatever the application—traditionally high quality DIAMOND Roller Chain Drives assure long, continuous, trouble-free performance . . . easy, economic maintenance.

**Write now for your copy of latest DIAMOND Chain and Sprocket Catalog!**

**DIAMOND CHAIN CO., Inc.**
A Subsidiary of
American Steel Foundries
Dept. 718 • 402 Kentucky Avenue
Indianapolis 7, Indiana

Circle No. 21 on Reader Service Card



## Dodge acquires French firm

MISHAWAKA, IND.—Dodge Mfg. International A. G. has acquired 40 per cent ownership of a new company in northern France to be known as Colmant, Cuvelier, Dodge S A. The company, which will extend Dodge's operations into the European Common Market, will make Taper-Lock sheaves and other products. Claude Cuvelier, president of Colmant & Cuvelier, will direct the recently-built factory. Dodge interests will be represented by Arthur Terry III, European manager of Dodge International.

## Bowmar Instrument doubles plant size

FORT WAYNE, IND.—A new plant addition that doubles the company's manufacturing area and production capacity has been opened by Bowmar Instrument Corp. at Fort Wayne, Ind. Totalling 23,000 sq. ft., the new facility has an electronically-equipped laboratory and specially air-conditioned sections for ultra-precision machining, heat treating and painting of components with tolerances measured to 1/10,000 of an inch.

# MEETINGS

**OCTOBER**

**17-19** American Society of Mechanical Engineers-American Society of Lubrication Engineers, Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

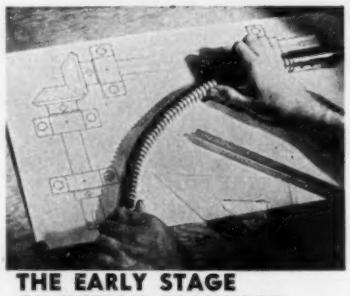
**24-26** American Gear Manufacturers Association, 1960 Semi-Annual, Edgewater Beach Hotel, Chicago, Ill.

**30-Nov. 1** National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

**3-4** Society of Automotive Engineers, National Fuels and Lubricants Meeting, The Mayo, Tulsa, Okla.

**27-Dec. 2** American Society of Mechanical Engineers, Annual Meeting, Statler-Hilton Hotel, New York.

SOLVE
power transmission problems with
STOW FLEXIBLE SHAFTING



THE EARLY STAGE OF DESIGN PLANNING IS THE TIME TO CONSIDER STOW FLEXIBLE SHAFTING.

Flexible Shafting can solve many complex power transmission problems normally encountered in transmitting power through a curved path or between components which have relative motion most efficiently, and more economically.

Use of standard or specifically designed power drive flexible shafting reduces or eliminates alignment and maintenance problems . . . does away with complex and expensive arrangements . . . removes danger of exposed moving parts.

*CHECK THESE ADVANTAGES:*

- **Simplicity of Design**—greater freedom to locate components . . . ideal for connecting components having relative motion.
- **High Efficiency**—ranging from 80% to 95%.
- **Safety**—replaces exposed universal joints and shafts in hazardous locations.
- **No Alignment Problems**—accuracy of alignment, so important on conventional drives, is not required.

*When next you have a specialized power transmission problem . . . check with STOW before designs have advanced too far. STOW engineers are ready to help you.*

*Write for Engineering Bulletin No. 570 and a free torque calculator.*

STOW
MANUFACTURING CO.
440 Shear St., Binghamton, N. Y.

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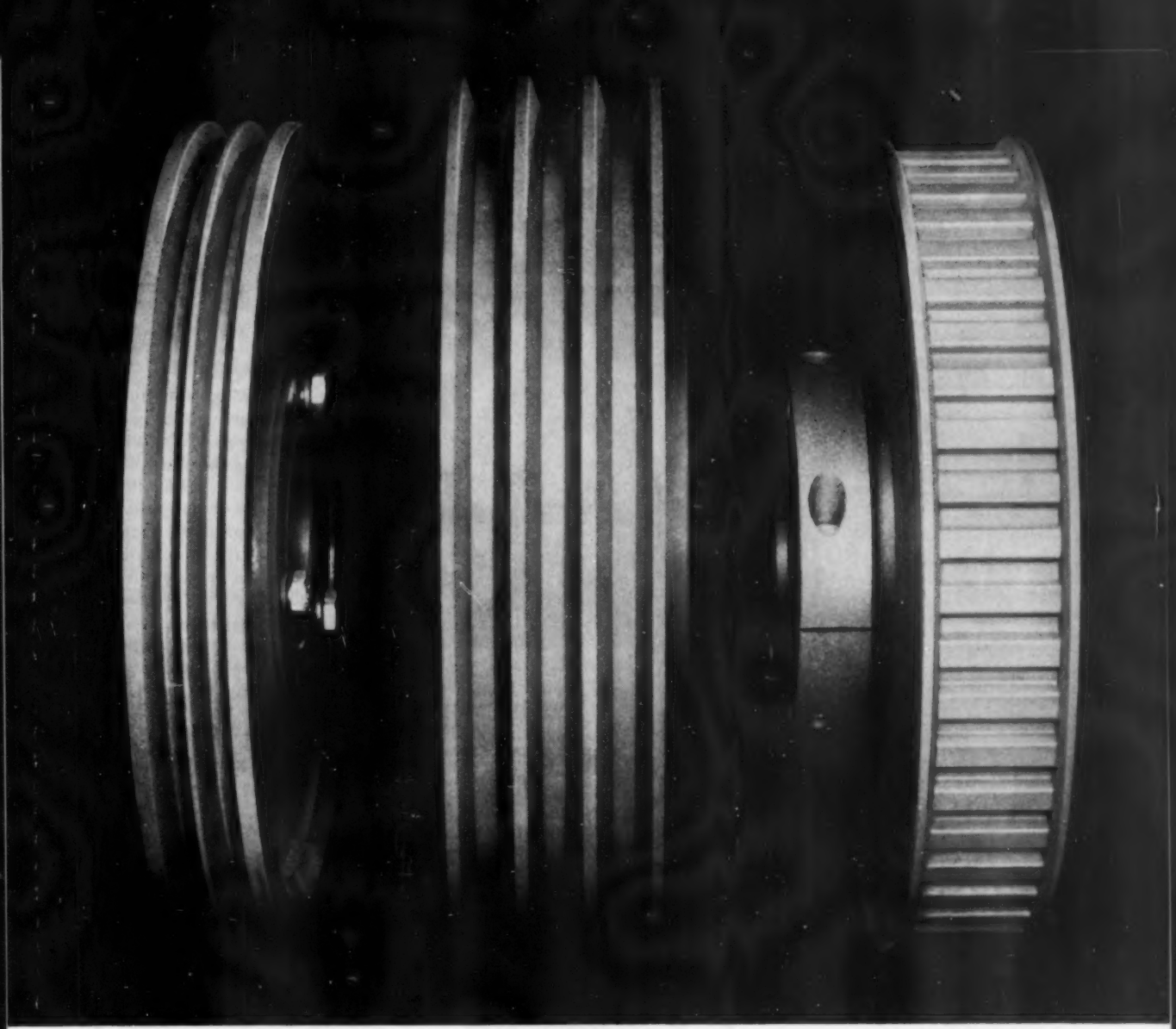


THE NEW MULTI-WEDGE DRIVE SHEAVE MULTI-V DRIVE SHEAVE POSITIVE DRIVE PULLEY

# FIRST, LOOK AT THREE

Measured by horsepower handled, the three wheels shown are the same. But Multi-V (long the industry favorite) is bulky, as compared with the new lighter, equally strong Multi-Wedge Drive. And the Positive Drive combines advantages of the chain and gear with the advantages of the belt.

For all three, even in fractional sizes, Worthington supplies the tapered, split QD hub with the Golden Screws. Or, of course, it supplies bored-to-suit hubs for special applications. And for every drive, from 1/20 hp to 600 hp or more, the proven Worthington-Goodyear belts are supplied. In fact, the QD hub plus these belts in any of the above three drive types make them most compact, flexible and long-lived.

Which drive you choose is up to you. But don't toss a coin. To help you decide, Worthington has just issued new engineering manuals on all three drives, including "how-to-figure-it" information. For low horse power drives, get the "Fractional HP" manual. Ask the Worthington distributor listed in the Yellow Pages for the manual(s) you want. Or send the coupon listed below.

**WORTHINGTON CORPORATION**
**Section 79-33, Oil City, Pa.**
Please send me the engineering manuals checked here.
☐ Multi-Wedge ☐ Multi-V ☐ Positive Drive ☐ Fractional HP

NAME_____
COMPANY_____
STREET_____
CITY_____ STATE_____

WORTHINGTON

**Circle No. 58 on Reader Service Card**

Fast Delivery

Quality

SIMONDS
INDUSTRIAL
CUT GEARS

★ FINISHED GEARS
★ CUSTOM GEAR CUTTING
★ HEAT-TREATED, CASE OR FLAME-HARDENED

You are sure of quality and prompt service when you place your industrial cut gear requirements with SIMONDS GEAR. We produce the full range of sizes in the types and materials you need from your blanks or ours. Let us quote on your next gear requirements.

* * *

*Stock carrying distributors of Ramsey Silent Chain Drives and Couplings; and industrial V-belts.*

SPUR GEARS
BEVEL GEARS
MITRE GEARS
WORMS • WORM GEARS
RACKS • PINIONS
Cast or forged steel, gray iron, bronze, Meehanite, rawhide or bakelite

MEMBER OF AGMA

THE SIMONDS GEAR & MFG. CO.
LIBERTY at 25TH PITTSBURGH 22, PA.

Quality Gears for over 65 years

Circle No. 48 on Reader Service Card


## MEN of the power transmission field

### Stafford sales manager of Jones Machinery Div.

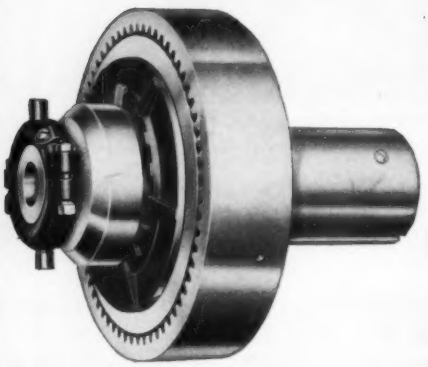
CHICAGO, ILL.—Milton C. Stafford has been appointed manager of product sales of the Jones Machinery Div., Hewett-Robins, Inc. Stafford is a graduate of the University of Minnesota, where he majored in mechanical engineering. He was formerly Chicago district manager for Jones products.

STAFFORD

### Walter P. Schmitter dies

MILWAUKEE, WIS.—Walter P. Schmitter, engineering vice president of The Falk Corp. and an internationally known engineer, died Sept. 5 at the age of 62. Associated with Falk since 1924, he was the originator of the Schmitter Rational Gear Formula, adopted in the thirties by AGMA as the standard of the industry. A past president of AGMA, in 1944 he was selected by the Association to receive the Edward P. Connell award for his contribution to the design and development of gearing. He was the patentee of over a hundred improvements in mechanical power transmission.


What Some Folks Won't Do to use a CONWAY CLUTCH!



TODAY . . .

we look at the Conway Sleeve Clutch (illustrated) and think of all the work we must do so it will fit our jobs.

IN THE OLD DAYS,

folks looked at the same Conway Sleeve Clutch and thought of how much work it would save. Do you know that some of those old-timers put the flat belt right smack-dab on the hub! Now, that's downright miserly*.

Hence, if you are averse to work—you know, like cutting keyways and mounting sheaves, gears and sprockets—JUST LET US DO IT. We, at Conway Clutch, are crazy about it (Work, we mean.) Write us and ask about integrated clutches.

**Anyone for penny-pinching?*

The CONWAY CLUTCH COMPANY

2754 COLERAIN AVE. CINCINNATI 25, OHIO

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## Four new executives at SKF

PHILADELPHIA, PA.—Four executives have been appointed to key posts in SKF's Altoona and Philadelphia plants. William C. Wright takes up the newly created post of general manager, Altoona Div.; James A. Graham, formerly plant manager, Philadelphia, succeeds Wright as production manager; Stanley Kabala, formerly Altoona plant manager, becomes plant manager, Philadelphia; and Woodrow Wilson, Altoona supervisor of factory engineering and maintenance, was named Altoona plant manager.

## Radke promoted controller of Cleveland Worm and Gear

CLEVELAND, OHIO—William B. Radke, formerly auditor, has been pro-

RADKE

moted to controller of the Cleveland Worm and Gear and Farval Divisions of Eaton Manufacturing Co. He succeeds Floyd H. Neel, who is retiring after 43 years. Radke, a graduate of Northwestern University, joined the Eaton Farval Division in October, 1957 as auditor after working for a number of years with the Stouffer Corp. and the Cleveland City Forge Co. He is a member of the National Association of Accountants.

## Simplatrol names Woodman Southeastern rep.

WORCESTER, MASS.—B. S. Woodman has joined Simplatrol Products Corp. as Southeastern district engineering representative.


FOR OEM

- Controlled single or multiple cycling within a wide range of speed.
- Clutch and brake in a single synchronized unit.
- Adaptable to mounting on crank, cam or drive shaft for flywheel or geared applications.
- Can be used with flywheel, gear or drive spider and mounted outboard or between bearings.
- Constant or variable clutch torque.
- Compact, space-saving, easily installed.
- Minster Electrical Controls to your requirements.

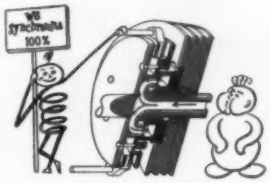
Write for OEM Clutch Bulletin CFC-54.

**Combination Clutch and Brake**

Air-Operated • Compact

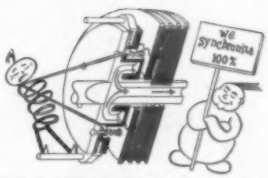
Fast Acting • Perfectly Synchronized

RUN




AIR IN—CLUTCH ENGAGED—(brake off)

STOP




AIR OUT—BRAKE APPLIED—(clutch disengaged)

FOR PRESS CONVERSION

A Minster clutch conversion is the most profitable way to increase press efficiency. It eliminates downtime . . . reduces maintenance and parts replacement . . . increases die life . . . reduces operator fatigue . . . improves safety and increases production.

Minster conversion units, made by a press manufacturer who knows your problems, are standard clutches individually applied to your press. Complete with flywheel and shaft, ready to drop in place. Thousands in daily use.

Write for Clutch Conversion Booklet CC57.

THE MINSTER MACHINE COMPANY · MINSTER, OHIO

MINSTER®

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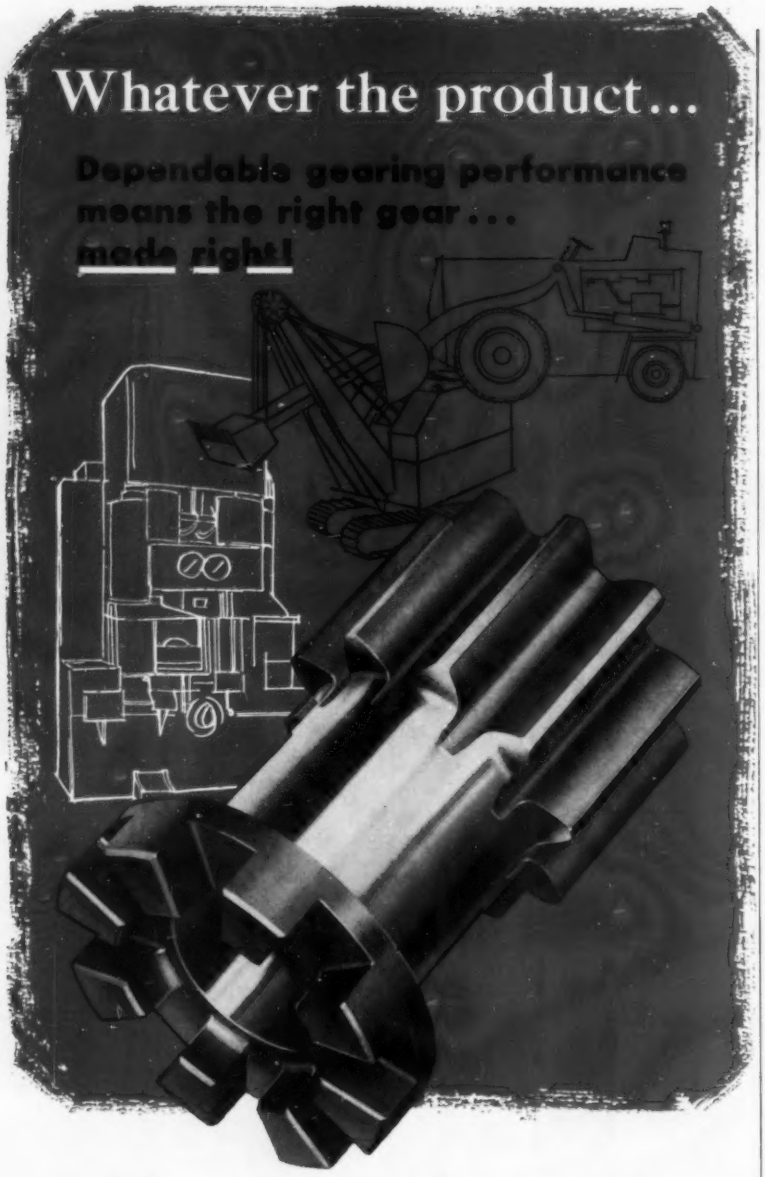


Precision can be designed into any power transmission equipment. But precision performance results only when the gearing is made to the exact specifications for a particular application.

CINCINNATI Custom gears and gear boxes are precision made, precision inspected, GUARANTEED—*with delivery dates as promised!*

**Send us your prints for quotation.**

CINTI®

**THE CINCINNATI GEAR CO.**

Mariemont Ave. Cincinnati 27, Ohio

Custom Gear Makers Since 1907

**GEARS, good gears only**

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**MEN** *continued*

## Tann Corp. picks new product managers

DETROIT, MICH.—Tann Corp. has appointed vice presidents-general managers for two of its subsidiaries set up to manufacture new products. John Glass will head Tann Bearing Co., producers of hydrodynamic oil

GLASS

RADNOR

film bearings. Michael Radnor will manage Tann Controls, whose major product will be proximity switches. Glass was earlier a general manager of Wagner Bros. Equipment Div. and vice president-general manager of Studrive, Inc. Radnor, a graduate of the London School of Economics, was a senior manufacturing engineer for Westinghouse Corp. small motors div. before joining Tann.

## American Pulley chooses Marsh as factory manager

PHILADELPHIA, PA.—American Pulley Co. has appointed Vernon Marsh as factory manager of its Philadelphia plant. Marsh, who was formerly general manager of factory operations for Kromex Co., has over 20 years experience in production and manufacturing methods. Previously he was with Coleman Co. as factory manager, and with Mid-States Mfg., Inc. as general manager and executive vice president.

## Dayton names Seammen district manager

MELROSE PARK, ILL.—Frank H. Seammen has been named district sales manager in Florida and Georgia territories by Dayton Industrial Products Co. He'll handle Dayton's line of V-belts, radiator and heater hose and other automobile items. Prior to joining Dayton, Seammen worked in rubber product sales in the southeastern states. He attended the Universities of Houston and Florida.

# Only BOSTRON V-Belts

## *are made with...*

## BOSTRON Tensile Members PLUS NEOPRENE with FIBER-DISPERSED Stock

**GREATER STABILITY** — Changes in humidity — and the resulting moisture regain — often mean a matching problem with ordinary V-Belts. The moisture regain of BOSTRON is low — 0.4% — or 1/20th that of the conventional reinforcing fiber. This means far less time spent in matching, and lower belt inventory too.

**HIGHER STRENGTH** — Stronger belts can withstand more shock loading, need less maintenance. BOSTRON is approximately 40% stronger than the conventional fiber used in V-Belts.

**STRETCH RESISTANCE** — V-Belts reinforced with BOSTRON have low stretch. BOSTRON is inherently stretch-resistant and the cords are put through a special heat and tensioning process to further minimize stretch. Thus, belts reinforced with BOSTRON show comparatively little growth — even after many months of continued operation.

**GREATER RESISTANCE** to oils, heat, abrasion, chemicals and ozone is provided by Neoprene.

**HIGH CROSS-WISE RIGIDITY** is provided by the closely-packed, straight-line formation of the fibers in the compression member.

**EXCEPTIONAL LENGTH-WISE FLEXIBILITY** is provided by the virtually frictionless positioning of fibers.

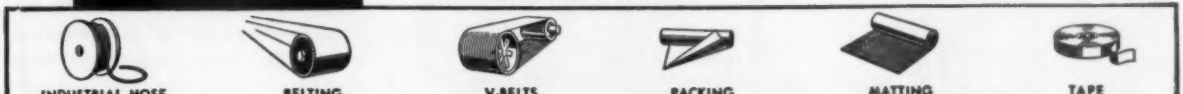
**EXTRA SUPPORT** for the tensile members during shock-load impact and during normal operation.

**The industry's most advanced developments are now standard in the entire BOSTON Multiple V-Belt line!**

● CUT DOWN MAINTENANCE ● MAINTAIN SMALLER INVENTORY ● SAVE MATCHING TIME ● SAVE TAKE-UP TIME

**BOSTON**

BOSTON WOVEN HOSE & RUBBER COMPANY
DIV. OF AMERICAN BILTRITE RUBBER CO., INC.
BOSTON 3, MASS.

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READY TO INSTALL!

GLOBE
Hardened Steel
MITER GEARS
Complete with
Keyway and set screw

Globe's new HMK Miter Gear Series eliminates additional machining and costly delays.

FROM STOCK
4 to 16 PITCH

Available through
Leading Power Transmission
Distributors

GLOBE STOCK GEAR DIVISION
34TH AND CLEARFIELD STREETS
PHILADELPHIA 32, PA.

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## Norma-Hoffman elects Baxter

STAMFORD, CONN.—Howard A. Baxter has been elected vice president in charge of engineering for Norma-Hoffman Bearings Corp. He succeeds

BAXTER

Warren D. Anderson, who continues as engineering consultant to the president in addition to outside activities in development and consulting engineering. A graduate of Iowa State with a B.S. in mechanical engineering, and post-graduate work at UCLA, Baxter will be responsible for all engineering functions, including machine and product development, sales engineering and research. Previously he was with Hughes Aircraft Co. as head of the mechanical design section of radar laboratories and with Bell Telephone Laboratories as mechanical project engineer.

## Johns-Manville makes Smith vice president

NEW YORK, N. Y.—Arthur C. Smith has been appointed a vice president and director of plant engineering of the Johns-Manville Products Corp. In his new post, he will be responsible for the J-M plant engineering program and will guide the company's two major engineering departments at Manville, N. J. and Waukegan, Ill. Smith came to J-M in 1940 as assistant plant engineer and was made chief plant engineer in 1954 after assignments as project engineer on construction, and building products div. production engineer. He holds a B.S. in mechanical and electrical engineering from Northwestern University.

## Beswick named Bendix eastern sales manager

MADISON HEIGHTS, MICH.—Albert N. Beswick has been made eastern regional sales manager for the Bendix Filter Div. of The Bendix Corp. Formerly a sales engineer for the same division in the middle Atlantic states, Beswick will work at the main plant in Michigan and supervise the eastern sales effort for a wide range of fluid and air filter products.

## Pomo joins Precision Bearing

OMAHA, NEB.—A. Pomo has joined Precision Bearing and Transmission Co. as assistant to the vice president. He will be in charge of personnel and will also head a new department for handling credits and supervising office procedures and stock control.

## Vickers names director of research

DETROIT, MICH.—Dr. W. Wai Chao has been appointed director of research and development at Vickers Inc., Div. of Sperry Rand Corp. Prior

WAI CHAO

to joining Vickers in 1959 as chief of research, Dr. Chao directed engineering efforts for such major projects as the second stage liquid rocket engine for the Discoverer program and altitude control rocket systems for "Project Mercury" and the X-15 airplane. He received a B.S.M.E. from the National Tung-Chi University in China and his M.S. and Sc.D. degrees from M.I.T.

Dr. Chao is a member of IAS, ARS, ASME, SAE, Combustion Institute and has served as representative on the Liquid Rocket Committee of AIA.

## Dayco's Fuller now asst. purchasing director

DAYTON, OHIO—Carl A. Fuller has been named assistant director of purchases for the Dayco Corp. He succeeds C. A. Griep, retiring after more than 28 years with the company. Fuller joined Dayco a year ago as senior buyer for maintenance equipment and supplies. A graduate in mechanical engineering of Akron University, he was formerly a purchasing agent for one of the large rubber companies.

Griep came to the company in 1932 and has worked in the purchasing department since 1942.

## Pfeifer heads merchandising at Chain Belt

MILWAUKEE, WIS.—G. H. Pfeifer has been appointed director of product merchandising and public relations by Chain Belt Co. He'll be responsible for all the company's advertising, sales promotion and public relations, as well as coordinating product merchandising. Pfeifer joined the company in 1933, was appointed advertising manager in 1943, and manager of sales promotion and advertising in 1955.

## Furlow joins R. C. Brown Co.

DALLAS, TEXAS—C. F. Furlow, Jr. has joined the R. C. Brown Co. as head of the Houston office. He will

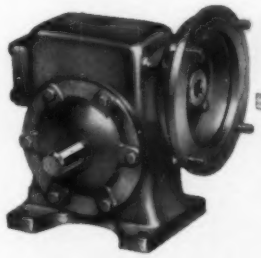
FURLOW

be responsible for the sales and engineering of equipment in South Texas and Lower Louisiana. For the past five years Furlow has managed a Houston equipment supply company.


956 different motorized speed reducers

*available from stock*

Yes! 956 different combinations of Perfection Motorized Worm Gear Speed Reducers are available for immediate delivery, *from stock.* Ratios range from 5 to 1 to 60 to 1, in capacities from 1/6 H.P. to 5 H.P. Perfection "C" Flange Reducers may be ordered complete with motor or without motor, to be used with a motor *of your own choice.*



Flanged motor reducers offer the maximum in compactness, rigidity and adaptability. Through the use of standard NEMA face mounted motors, complete interchangeability between motors is provided. Motor maintenance is possible without disturbing the drive and reducer. Motor assembly is fast and positive with no alignment problems.

**Write for your free copy of our new 28 page catalog containing illustrations, charts and tables to help you choose the right Reducer for your particular application. Ask for Bulletin No. M-140.**

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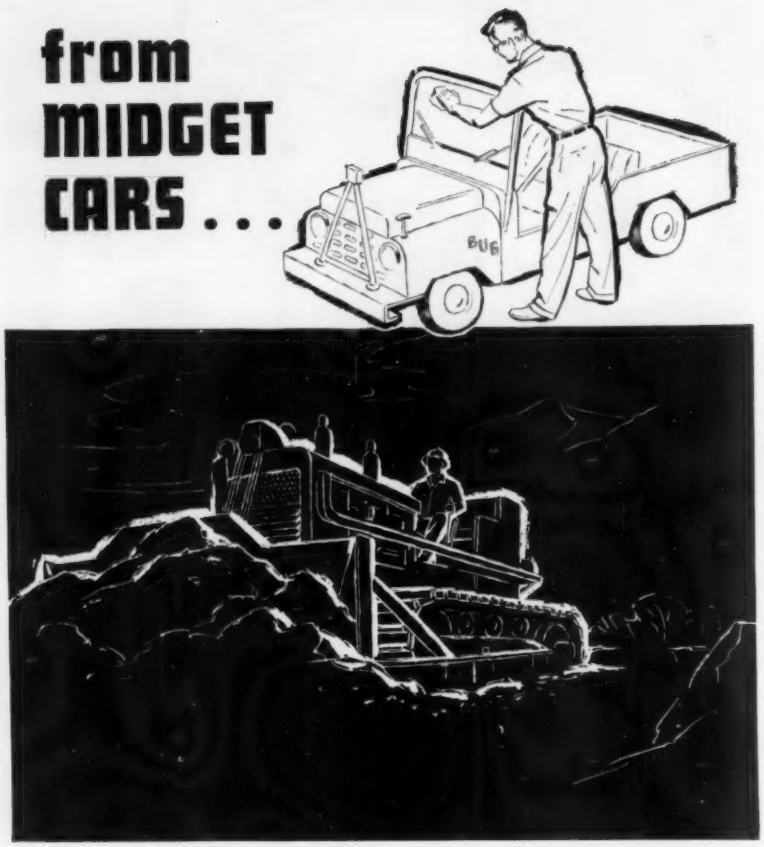
# from MIDGET CARS . . .



# to MIGHTY CRAWLERS

Both are driven by Rockford Spring-Loaded Clutches. These versatile power-links drive many vehicles of all types and sizes. Torque loads range from 50 to 2,530 ft. lbs.! Sizes vary from the compact 6″ clutch to the powerful 16″ double plate unit. Positive, full-motion driving power with smooth starts and controllability is yours with Rockford Clutches. Write today for illustrated brochure.

SPRING-LOADED ROCKFORD CLUTCH

**ROCKFORD CLUTCHES**

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## Warner Electric names Keefer president-controller

BELOIT, WIS.—William W. Keefer has been named president-controller of Warner Electric Brake & Clutch Co. Prior to joining Warner, Keefer was with United States Steel as a financial executive. He also served as a consultant with the A. T. Kearney Co. A graduate of Chicago University, he did graduate work at M.I.T. and the University of Copenhagen.

## Wallace becomes v.p. at Bearing Headquarters Co.

CHICAGO, ILL.—Zearl B. Wallace has been made a vice president of Bearing Headquarters Co., Div. of Ray M. Ring Co., Inc. He has been with Bearing Headquarters since 1948. In 1952, he became a sales manager and then managed the company's Calumet office when it was opened in 1954. Since 1954, he has also been acting as a steel mill specialist. He will continue to head the Calumet office.

## Garlock appoints Henderson supervisor in research

PALMYRA, N. Y.—Garlock Inc. has appointed Jack A. Henderson supervisor of research and development section, engineering department. Henderson has attended California Aero Tech and the California Institute of Technology, and has worked for the Curtiss-Wright Corp., Merck & Co. and Becton Dickinson, Inc.

## Gard fills new post at Dodge

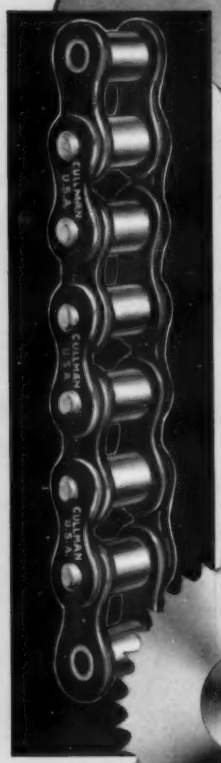
MISHAWAKA, IND.—For closer contact with its more than 500 authorized distributors, Dodge Mfg. Corp. has assigned Lawrance R. Gard, Jr. to a new position of assistant manager of distributor sales. Before coming to Dodge, Gard owned and operated the S. D. Callaway Co., Inc., industrial distributors. Previously he had been with Dodge in 1952 as sales rep. for the Kansas-Missouri district.



Circle No. 16 on Reader Service Card ——→

# cullman

## cullman ROLLER CHAIN DRIVES



## Sprockets and Chains for Better Power Transmission!

• More than 98% power transmission efficiency is one proof of the important advantages you get with CULLMAN ROLLER CHAIN DRIVES. They're dependable, flexible, economical . . . proved in over 65 years of service to industry.

Cullman Sprockets and Roller Chains are carried by leading industrial distributors everywhere.

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complete with keyways, setscrews and hardened teeth are designed to correct angular misalignment or to connect a motor directly to a machine. Bore sizes from 7/16" to 4⅝" diameter; fractional to 420 horsepower ratings; off the shelf.

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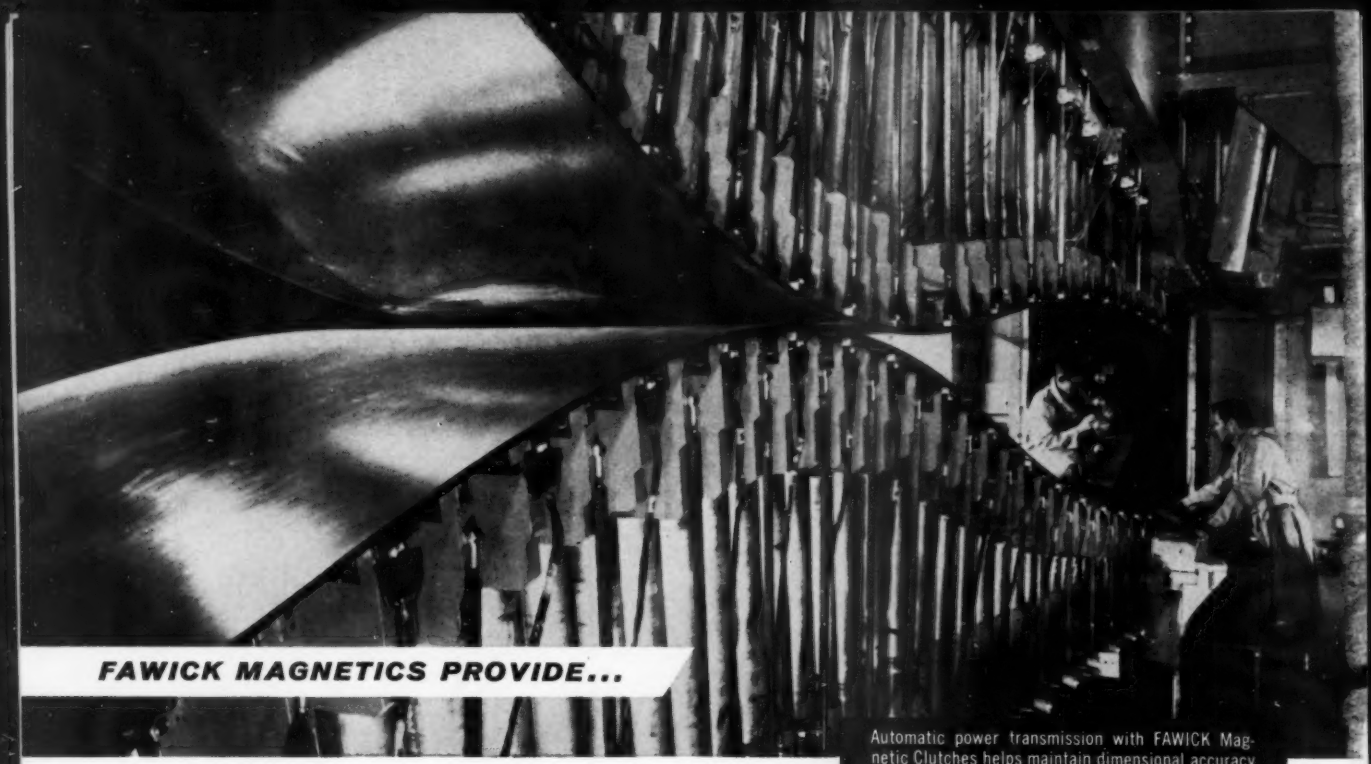
*Roller Chain Drives Since 1893*

# wheel



**FAWICK MAGNETICS PROVIDE...**

# ...fast, automatic positioning to ±.002" at Mach 6!

MEETING the most demanding requirements for automatic power transmission is a specialty of FAWICK Magnetic Clutches. Proof of superior performance is found at the world's largest known Mach 6 wind tunnel—at the U. S. Air Force's Arnold Engineering Development Center—where only the finest systems and components are used to assure optimum conditions during testing of aerospace configurations.

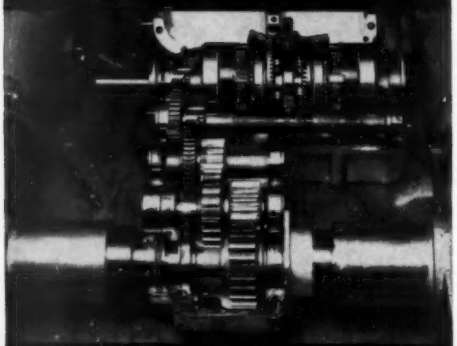
Here 160 Magnetics are integrated with an ultra-sensitive control system which establishes and maintains the internal contours needed to achieve simulated air pressure and velocity. As shown here, these contours are provided by flexible nozzle plates of stainless steel which form the tunnel's top and bottom walls. Plates are positioned with 80 ball-screw jacks each driven through two Magnetic Clutches.

To set up a test, the master control is dialed to the desired Mach number. This sets 80 potentiometers, one at each jack station, to signal the necessary "extend" and "retract" action which establishes the correct nozzle aperture and plate curvatures. Changes in velocity are made during operation merely by changing the master dial settings. A feedback system immediately readjusts any portion of the nozzle forced out of position by pressure.

Operation of this highly automated system depends on efficient power transmission. The Magnetics' job is to actuate the jacks in response to the plate-positioning signals. *They do it instantly . . . and dependably . . . under all conditions of tunnel operation from Mach 1.5 to Mach 6 . . . to an accuracy of ± .002 inch!*

This is just one example of Magnetics in action. For detailed information on how they can fit into your automatic equipment designs, contact your nearest FAWICK representative or the Home Office, Cleveland, Ohio.

Automatic power transmission with FAWICK Magnetic Clutches helps maintain dimensional accuracy of nozzle and test section in world's largest known Mach 6 wind tunnel. Tunnel is part of the von Karman Gas Dynamics Facility, operated by ARO, Inc., operating contractor for the USAF's Air Research & Development Command wind tunnel center in Tennessee.



Two SC-375 Magnetic Clutches, one for "extend" and one for "retract" action, are mounted inside gear housing at base of each of 80 jack stations. Clutches operate in "oil", with torque ratings of 275 in.-lbs. starting and 340 in.-lbs. running.

Photos and information courtesy of ARO, Inc., a subsidiary of Sverdrup and Parcel, Inc.

**FAWICK AIRFLEX DIVISION**
**FAWICK CORPORATION**
9919 CLINTON ROAD • CLEVELAND 11, OHIO
Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada

**FAWICK MAGNETIC**
INDUSTRIAL CLUTCHES AND BRAKES

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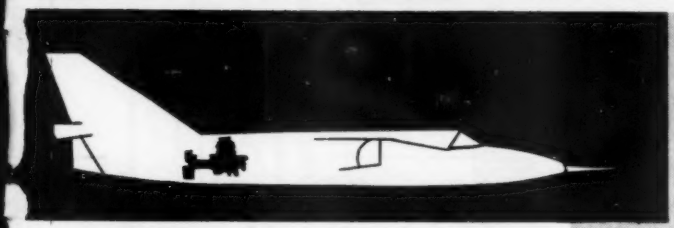


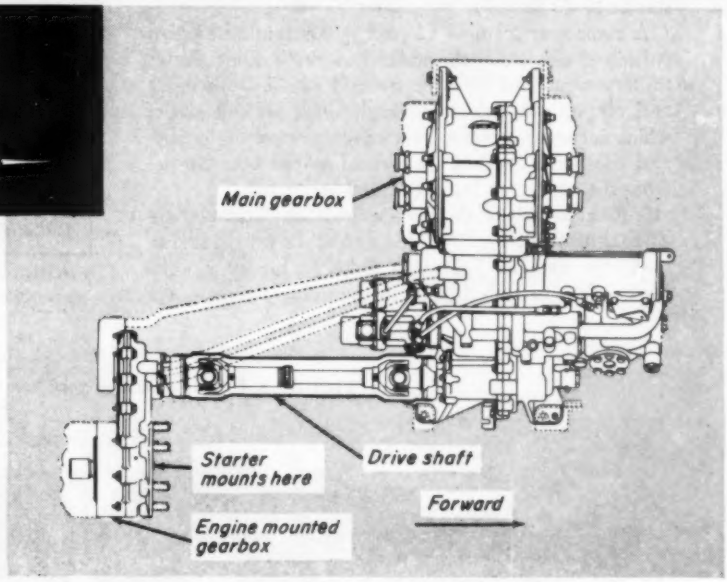



FIGURE 1. General layout and location of F-106 constant-speed generator drive system.

POWER
TRANSMISSION
DESIGN OCTOBER, 1960

# The F-106 Constant-Speed Generator Drive

## . . . an unusual power transmission problem

By P. W. Corbett,
*propulsion group engineer, Convair Div., General Dynamics Corp.*

Driving four generators at constant speed from a jet engine with a speed range of almost 2:1 is a problem all by itself. In addition to this, light weight, remote installation, accessibility, engine elongation due to thermal expansion, and fore and aft motion of the engine from thrust had to be dealt with in designing the system.

ELECTRIC power, 41.5 kw of it, is needed to power complex electronic systems on the F-106 Delta Dart. Since this power is 400 cps ac, the generators which provide it must operate at very steady speeds to keep frequency within $\pm 0.2\%$ or $\pm 0.8$ cps. The system that does this is made up of an engine-mounted gearbox, a telescoping shaft with a universal joint at each end, and the main gearbox, Fig. 1.

The main gearbox is the real heart of the system. It contains the hydro-mechanical constant-speed drive unit to maintain constant alternator drive speed while input to the gearbox varies between 3920 and 7260

rpm. The four generators are flange mounted on the main gearbox, which also contains gearing to split the input power four ways. Sundstrand Aviation Div., Sundstrand Corp. designed and built the gear box and other major components of this drive system.

## Engine-Mounted Gearbox

Power takeoff from the engine is through this gearbox, Fig. 2. It is sandwiched between the engine starter and the starter mounting pad. Main function of this gearbox is simply to provide a power takeoff point for the generator drive system while allowing the starter to do its job.

A three-gear train of 12 pitch gears is used to give sufficient offset for the main box drive shaft. Input to output ratio of the gear train is 43:45. Both input and output gears drive through short splined shafts which incorporate shear sections to protect the engine and the main gearbox in case of severe over torque from the starter or from a frozen generator.

To keep weight down, the gearbox castings are ZRE-1 magnesium alloy. This and other weight-saving measures such as lightening holes in the gear webs kept weight to 14.5 lb. The magnesium castings made it necessary to use liners in the bearing bores. These are pressed-in and pinned.

This gearbox also incorporates a pump for circulating its lubricating and cooling oil through the main gearbox.

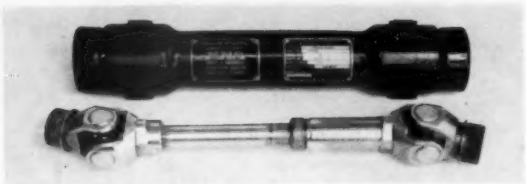


**FIGURE 3. Drive shaft and cover.**

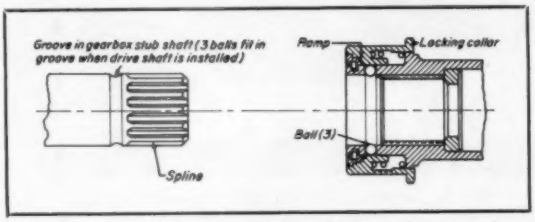



**FIGURE 4. Quick connect-disconnect system used at ends of drive shaft.**

**FIGURE 2. Engine mounted gear box disassembled.**

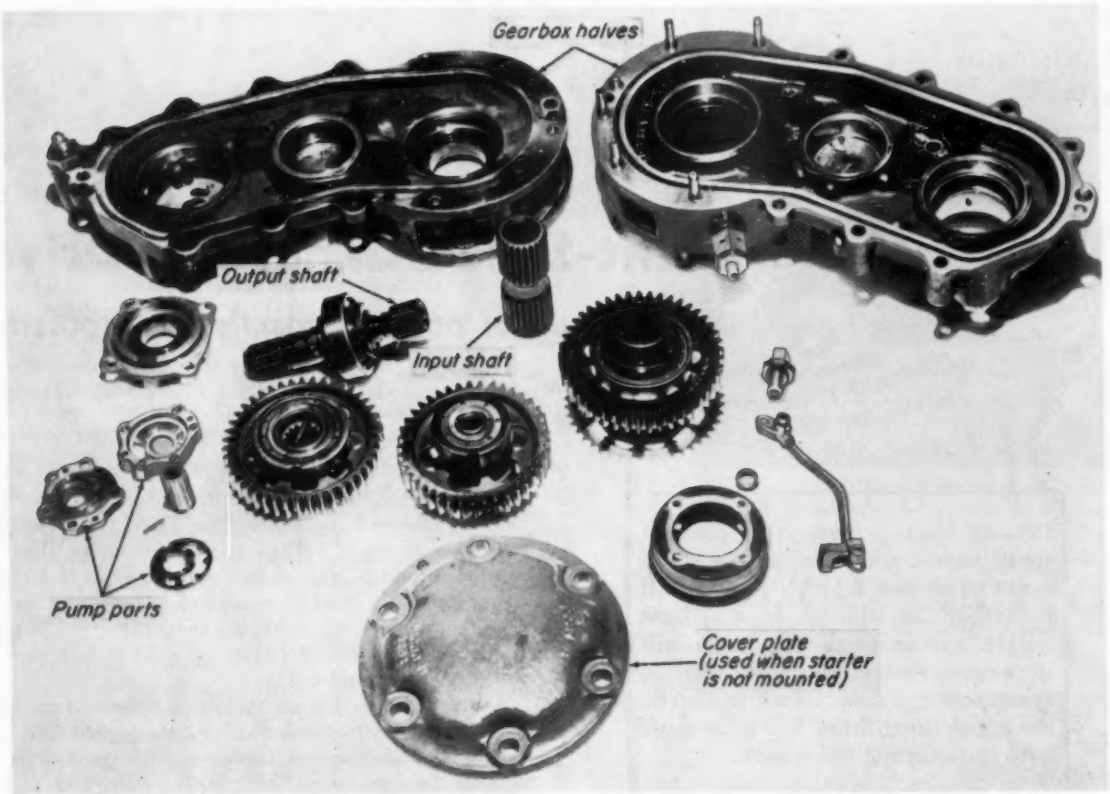


**FIGURE 5. Optical alignment gage cuts checking time from hours to minutes.**

## Driveshaft

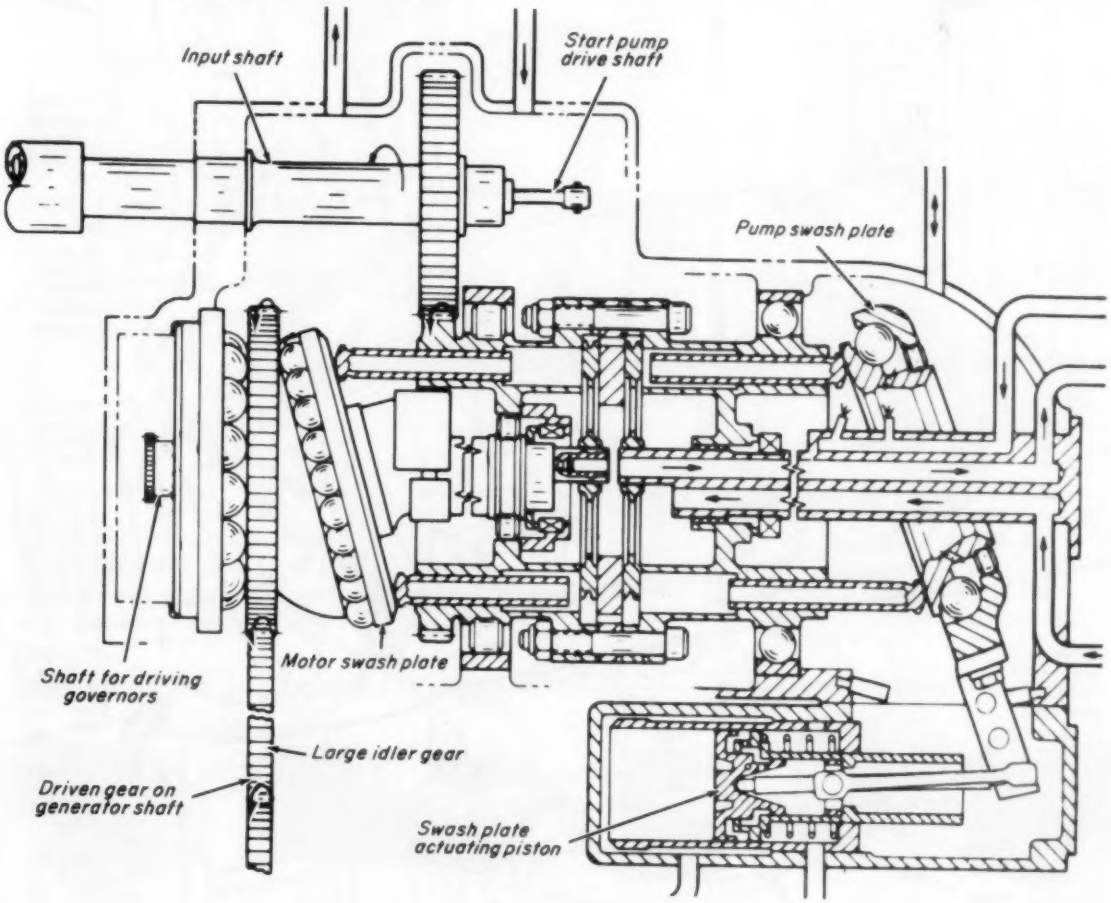
Because of its weight—300 lb with generators—the main gearbox couldn't be mounted on the engine. It had to be mounted on the fuselage structure. Misalignment, installation tolerances, engine growth from heating, and engine fore-and-aft movement due to thrust variations are all taken care of by a telescoping shaft with a universal joint at each end, Fig. 3.

The cross-type universal joints are nominally 12.20 in. apart. Stub shafts at both ends are internally splined and long enough to compensate for length variations of $\pm 0.5$ in. A telescoping spline in the center of the shaft lets it be collapsed 1.2 in. for installation and removal. One tooth of this spline is wider than the rest so the universal joints will be properly aligned when the shaft is assembled.

An interesting feature of this drive shaft is the quick connect-disconnect system. A spring-loaded locking collar at each end can be moved 0.15 in. axially to release three balls spaced 120 deg apart which fit into a groove on each gearbox stub shaft, Fig. 4. This speeds removal for servicing of both main and engine-mounted gear boxes.

A sheet metal cover over the shaft eliminates any danger from the rotating parts. Both cover and shaft assembly are within the weight limitation of 5 lb and are contained within a 3-in. diam circle.

**FIGURE 6. Constant speed unit in the main gear box is made up of variable-displacement hydraulic pump and constant-displacement hydraulic motor. Differential principle might be compared to motor at the center of a merry-go-round. No current to the motor, rpm = merry-go-round rpm. Motor running same direction as merry-go-round, shaft speed = motor rpm plus merry-go-round rpm. Motor running opposite direction, shaft speed = motor rpm minus merry-go-round rpm. And, motor rpm is continuously variable in this transmission.**



**Shaft alignment:** A novel optical gaging system, Fig. 5., was developed for checking alignment of the engine-mounted gear box output shaft and the main gear box input. Ordinarily, this check is necessary only after engine installation or structural damage to the airplane.

To use the gage, the driveshaft is removed and an optical projector mounted on the engine-mounted gear box stub shaft. A target is attached to the main gear box stub shaft. With the projector turned on, a dot is projected on one of the numbered concentric target rings. A mirror is then mounted on the target. The mirror reflects the light beam back to another target which is integral with the projector. If the spot falls within the circle on the projector target with the same number as the circle it hit on the other target, alignment is within limits. This system has reduced alignment check time from hours to minutes.

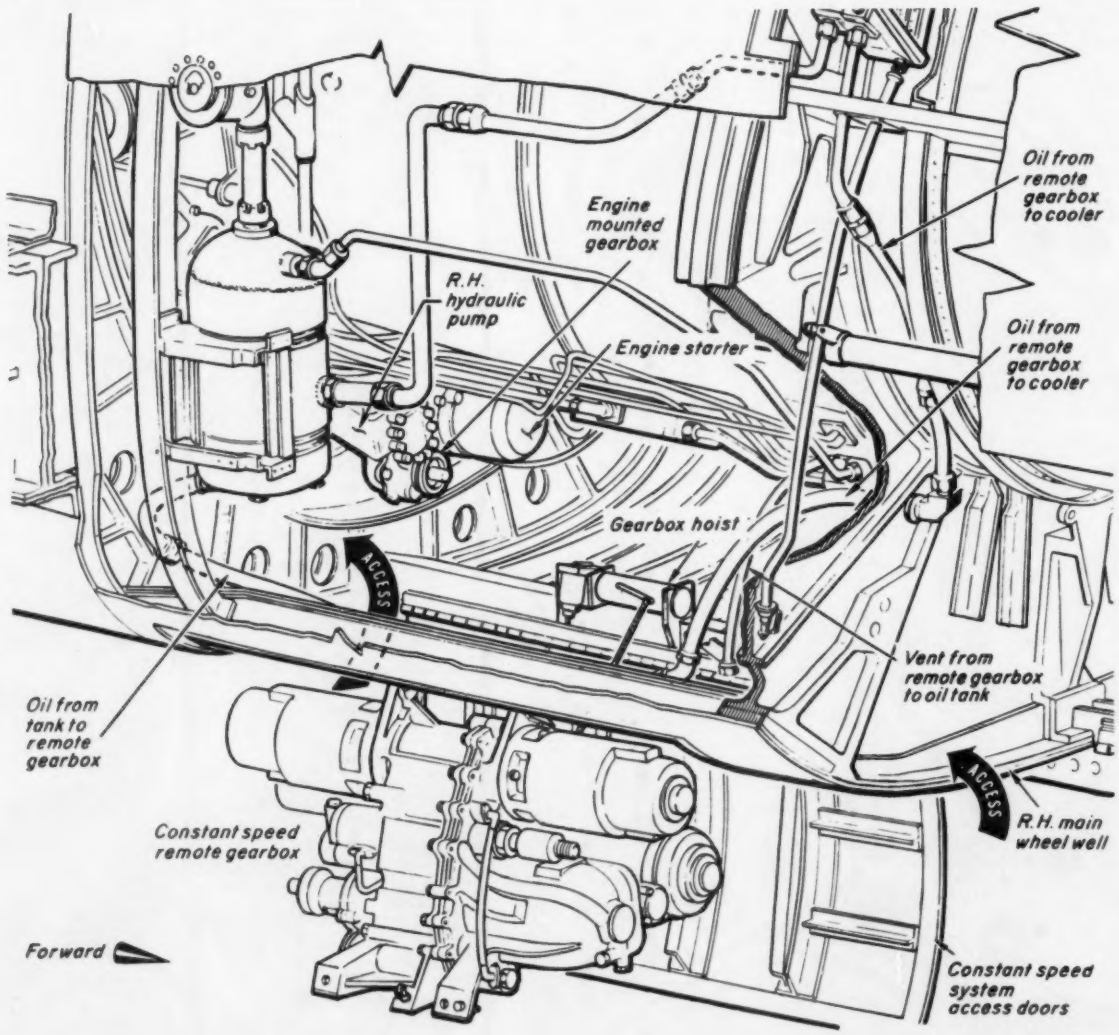
## Main Gearbox

This unit serves as the mounting for four generator units which supply eight forms of electrical power for various uses on the airplane. The varying input is converted into a constant output speed of 8000 rpm for one generator and 12,000 rpm for the other three.

Constant-speed transmission portion of this assembly is a hydro-mechanical transmission, Fig. 6. A rotating cylinder block assembly contains a variable-displacement, axial-piston pump and a fixed-displacement axial-piston motor. Displacement of the pump is controlled by a governor system. Depending on governor setting, the pump drives the motor either forward or backward and at the speed necessary to maintain constant output speed. Speed resulting from hydraulic flow either adds to or substracts from the speed at which the motor is being driven by the input from the jet engine. Power is transmitted both mechanically and hydrostatically in this unit.

*continued on page 68*

**FIGURE 7. Main gear box may be swung down out of the airplane for servicing.**



# IN WAGNER GEARDRIVES . . .

# HIGH-HARDNESS GEARS

## provide greater power transmission capacity . . . longer wear life . . . greater resistance to shock

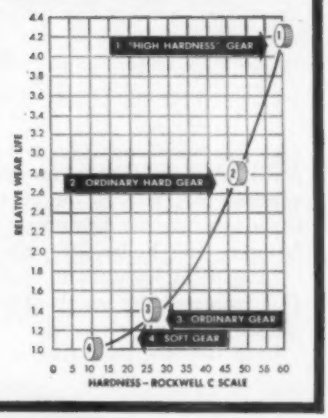
Wagner Gear Drives are built with "High Hardness" gears . . . made from forged blanks of alloy steel, carefully hardened *after* cutting. This special process develops file-hard tooth surfaces with tough, ductile tooth cores . . . maintains close-tolerance accuracy. High strength with high accuracy gives greater capacity, longer wear life than ordinary gears of the same size and weight, plus maximum resistance to shock. Table shows performance comparisons.

1. "High Hardness" gear . . . hardened *after* cutting. Precision processing permits maximum hardness while holding accuracy within extremely close tolerances.

2. Ordinary hard gear . . . hardened after hobbing and shaving. Hardness limited to maintain reasonable accuracy.

3. Ordinary gear . . . hardened before cutting. Hardening limited to maintain machinability.

4. Soft gear . . . excessive size required because of low capacity.

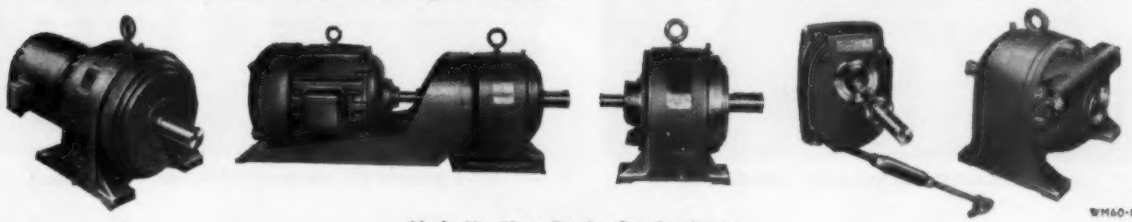



Positive, powerful, slower than motor speeds should mean one thing to you: Wagner Gearmotors. They are built to operate for years at peak efficiency. Advanced design and rugged construction with a minimum number of wearing parts, make this a certainty. Wagner Gearmotors have positive oil seals; continuous lubrication of all moving parts; extra-high capacity bearings; integral bearing housings; and rigid pyramid-mounted cast housings. Extra capacity bearings give them high overhung load ratings, too.

Wagner makes both integral-type and all-motor gearmotors, speed reducers and shaft-mounted speed reducers. They're available in single, double, triple or quadruple reductions . . . horizontal or vertical foot or flange mountings. Another important factor: prompt shipment. Standardized components permit immediate assembly of all standard sizes and types; you get equipment when you need it.

Want to know more? Call your nearby Wagner Sales Engineer; he will be glad to help you select the right drive for your application. Bulletin MU-227 gives full information.

**Wagner Electric Corporation** 6385 PLYMOUTH AVENUE, ST. LOUIS 33, MISSOURI



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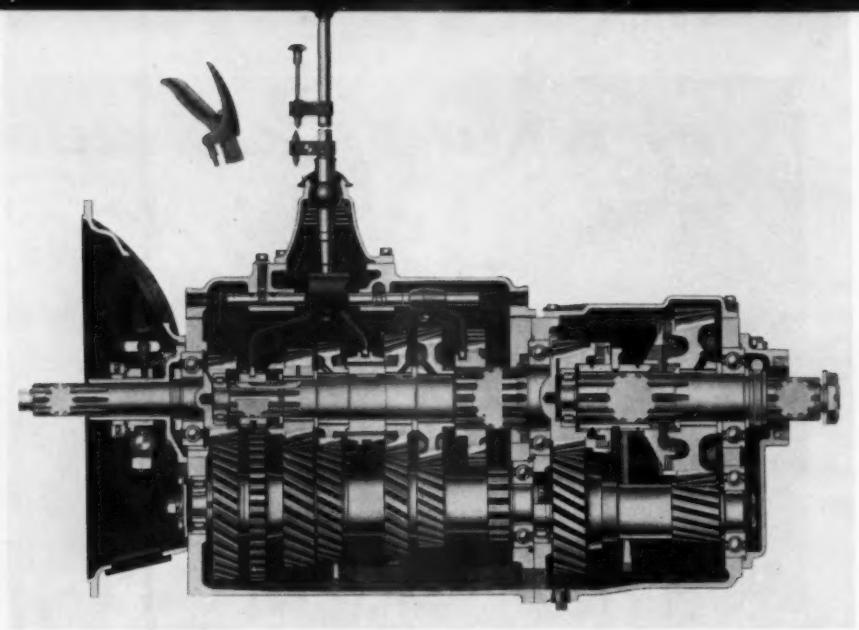
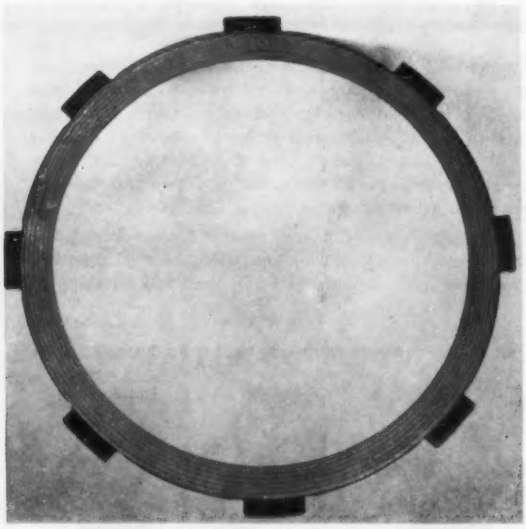


**ROADRANGER transmission has 10 forward speeds, all shifted with one lever. This means synchronizer shift time must be kept from increasing.**

# Disks keep shift time constant in transmission synchronizer

ACCURATE TIMING in heavy-duty multi-speed transmissions may rely on the durability of friction disks in the synchronizer assembly. One transmission manufacturer, The Fuller Mfg. Co., found that as these friction disks wore, their coefficient of friction fell. This increased the length of synchronization and decreased shift effectiveness.

Until recently, these friction disks sometimes failed after comparatively low mileage, despite the use of the best friction materials available. Today, the development of superior friction materials has extended the operating life of synchronizer friction disks, reducing maintenance costs.



**GROOVED FACING helps transfer oil.**

Raybestos-Manhattan, Inc., Equipment Sales Div., explored Fuller's problem and provided semi-metallic friction disks which improved synchronizer performance by maintaining a consistently high coefficient of friction throughout transmission life, and provided smoother engagement and greater durability. Past service problems from synchronization timing difficulties have been virtually eliminated.

The new friction disks are used in Fuller's *RoadRanger* transmission. The assembly, a 5-speed transmission with closely-spaced ratios and a 2-speed auxiliary with wider-spaced ratios, has 10 forward and 2 reverse speeds, all shifted with one lever. This is unusual, since, traditionally, multispeed transmissions needed two gear shift levers to make a similar shift.

You get 10 forward speeds by using ratios of the 5-speed section twice—the first time with the auxiliary section in low gear, so that ratios in the 5-speed section are compounded by the auxiliary gear; the second time with the auxiliary section in high gear.

In shifting from one set of 5 gears to the other, the synchronization clutch either speeds or slows the main shaft, thus synchronizing gears with the shaft. On the upshift, the synchronizer must bring the auxiliary drive gear to the same speed as the output shaft.

On the downshift, the auxiliary reduction gear must be brought to the same speed as the output shaft. The change of gear speed in either shift is 3½ to 1.

When upshifting from fifth gear, the synchronizer provides an automatic shift from low to high range in .4 second. Simultaneously, the 5-speed section is shifted into its lowest gear. With the auxiliary section in high range, the lowest gear in the 5-speed section is sixth.

Timing is important. If the automatic shift in the auxiliary section is not completed promptly, the driver can, by engaging the front box and the clutch before the back box is synchronized, force the friction disks to slip continuously. This creates intense heat, invites disk warpage, and causes synchronization troubles.

Slide-by in initial synchronizer engagement due to inadequate friction leads to a clashing shift in the auxiliary section, which damages clutch teeth. The new disks, by maintaining the initial coefficient of friction, provide constant, reliable synchronization timing in the auxiliary section of the transmission.

Raybestos-Manhattan, after analyzing the problem, prepared sample friction disks for testing in Fuller's Research & Development facilities. The disks were tested on laboratory transmission stands which simulated heavy-duty field operating conditions and over-the-road situations.

The test disks had a semimetallic, grooved friction facing of asbestos fibers, copper powder bonded with a synthetic resin, friction modifiers, and other fillers. The facing was bonded to a steel core. The facing was grooved to help transfer oil across the friction face, as the clutch facing had to run in an oil spray from adjacent gears. The grooving pattern is a 4-groove, single lead spiral.

An endurance test showed what change occurred in transmission shifting time at 10,000 shift cycle intervals. With disks previously used, shifting time varied in proportion to the age of the friction part, with more time required for synchronization as the part became worn. As shift time interval increased from the desired .4 second to .5, .6, etc., synchronization efficiency decreased.

The test consisted of 80,000 range shifts, equivalent to estimated minimum over-the-road transmission life. The entire transmission assembly was mounted and shifted through 80,000 range shift cycles—80,000 shifts up, 80,000 shifts down again. Timing of the automatic shift by the synchronizer assembly was measured by an oscillograph, recording the time interval of a complete shift within a few thousandths of a second.

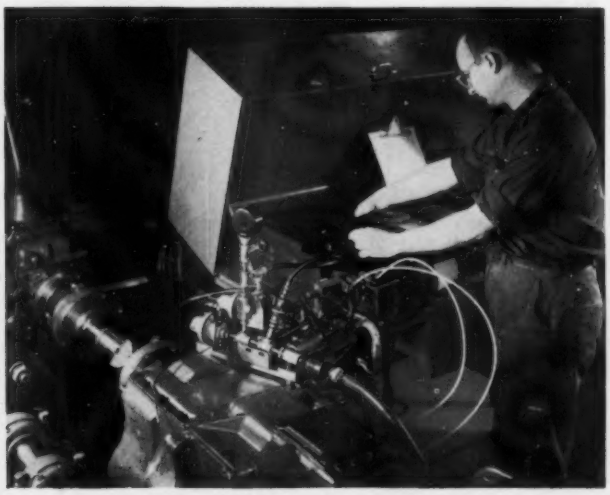
The test showed that:

- Friction parts blocked solidly both initially and after 80,000 range shift cycles.
- Cycle time remained constant, unlike previous materials which deteriorated.
- Friction parts were durable, with a satisfactory wear rate.
- A constant coefficient of friction was maintained beyond 80,000 shifts.

For field testing, the disks were placed in high-speed transmission packs and used in 12 general, over-the-road trucks. The transmission, synchronizer clutches, and accompanying clutch disks were road-tested for 30,000 miles, after which the synchronizer was dismantled and the disks inspected. Results:

- There was no disk warpage from excessive heat as in the past.
- Dimensions did not change, and tolerances were not exceeded.
- Timing, because of a consistently high coefficient of friction, was still good.

Materials formerly tried in the transmission assembly included sintered bronze on steel, steel on steel, sintered bronze on ground steel, and ground steel on ground steel. ▲▲▲



**OSCILLOGRAPH measures shift time.**

**DISKS used in synchronizer assembly.**

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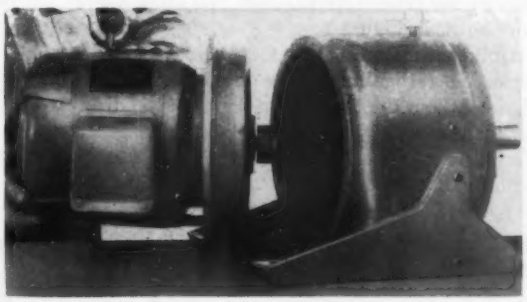
## Change gear ratios right in your own plant... Mr. Westinghouse and Moduline gear units bring simplicity and versatility to gearing applications

The modular design of Westinghouse Moduline* drives saves you time and money. Now you can change gears right in your own plant to take advantage of changing manufacturing techniques or improved processes. No more delays . . . Moduline never becomes obsolete, always permits rearranged configuration rather than expensive replacement.

And maybe you've already heard that we've stepped up our application assistance and manufacturing and delivery pace, too. We've moved our entire gearing department to the Buffalo Motor Plant to assure fast and complete coordination on any drive problem you may have. For any drive application, call *your* Man from Westinghouse. He's a drives expert well equipped to represent our Buffalo Division, industry's "controlled torque" headquarters. You can be sure . . . if it's Westinghouse.

*Trade-Mark

J-37371



One standard wrench is all you need to modify any Moduline unit. Gear pullers have been completely eliminated, and no special aligning or positioning of modules is necessary during assembly.

**Westinghouse**

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# Are printed

By R. P. BURR, *Circuit Research Co., affiliate of Photocircuits Corp.*

**FIGURE 2. Printed armature (left) with comparable conventional armature.**

PRINTED ARMATURES have fostered a new family of motors that may ultimately be produced inexpensively by automated techniques. Before discussing printed motors, let's look at the conventional design illustrated by the cross-sectional view of a large 8-pole dc motor shown in Figure 1.

The significant feature is that the whole structure is cylindrical. We recognize that the motor shaft passes through the large white area in the center of the drawing, and that the inner or revolving portion is generally referred to as the armature. The outer or stationary portion carries the pole structures, which, in this case, happen to be those of a wound field. Fundamentally, the air gap separating the rotating from the fixed parts is cylindrical, and the direction of the flux lines traversing the air gap is radial.

To visualize one of the most useful forms of printed motor, you must discard the cylindrical structure. To see why, compare a printed armature with a conventional armature, Figure 2. The printed armature shown has about the same power output as the conventional dc armature. The disc armature is 3.6 in. in diameter, .030 in. thick, and contains no iron. It weighs about ⅛ as much as the conventional one.

Obviously, the simplicity of the disc design promises substantial manufacturing economies. The winding, essentially a two-dimensional structure, readily lends itself to highly-automated production. In plant operations at Photocircuits Corp., the armature with its windings is produced by skills more closely allied to the printer's art than to fabricating by conventional machinery. The windings are made by printing and etching copper-coated insulating stock.

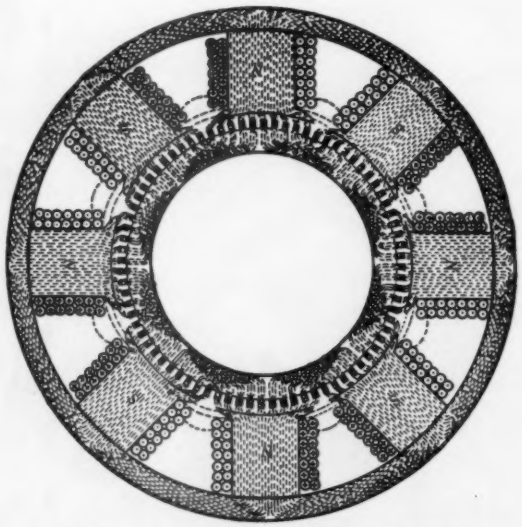

**FIGURE 1. Conventional 8-pole dc motor.**

# circuit motors practical?

The flat armature must be placed in a structure with a flat, planar or axial air gap. This principle is illustrated in a complete motor, Figure 3.

Also in Figure 3, you can clearly see certain essential features. The disc is shown within a field magnet structure. Note that the flux lines run parallel to the output shaft and that commutation takes place directly on the windings. The armature serves as its own commutator, or vice versa.

Figure 4, an exploded view of the same motor, emphasizes the fact that there are 8 magnetic poles in this design. These poles are alternately magnetized in north and south directions. From any pole face, magnetic flux passes through the armature, enters the rear soft iron shunt plate, travels circumferentially in the iron, re-enters the armature, and passes back to an adjacent pole face.

Since a detailed explanation of the armature operating principle would be quite involved, let's just say the winding is an 8-pole disc-shaped development of the wave or Gramme ring configuration of dc motors. For efficiency, you must have a large number of poles for the conductor layout. By carefully designing each turn shape, you can utilize a satisfactory portion of the disc area for torque generation. For example, 70% of the copper surface is effective in the motor shown in Figure 4.

## Advantages

The printed motor structure has specific advantages which should be considered when evaluating the device for a particular application. Let's outline some of them.

**Low cost.** We've already mentioned some of the manufacturing economies of the printed motor. Once the drawing, tooling, and processing for the armature are established, the price of the finished part will include very little direct labor cost.

Eventually—and we emphasize that the state of the art today is still far removed from this point—we expect the cost of the armature for a 10 hp motor will be $20 to $30. The manufacturing operations on the rest of the structure are such that it is again fair to assume we are close to the cost of the materials in mass production. Conceivably, the cost of the complete motor might be $100 to $150.

**Low inertia.** The armature has much lower inertia than its iron-cored counterpart. The mechanical time

*NOTE: The printed circuit motor evolved from an intensive development program by three American companies working with the French inventors, J. Henry-Baudot and F. H. Raymond of the Societe d'Electronique et d'Automatisme. The invention was introduced to this country by Printed Motors, Inc., New York. The new electrochemical and printing techniques required to make the device commercially practical were perfected by Photocircuits Corp., Glen Cove, N. Y. Electrical and electronic engineering were done by Circuit Research Co., Cold Spring Harbor, N. Y.*

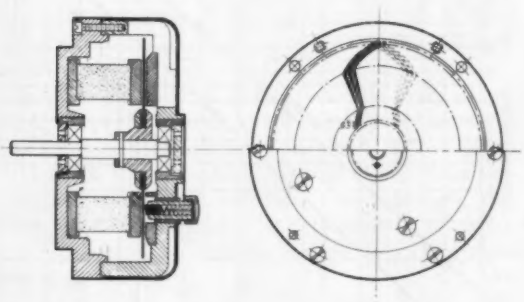

FIGURE 3. Complete printed circuit motor

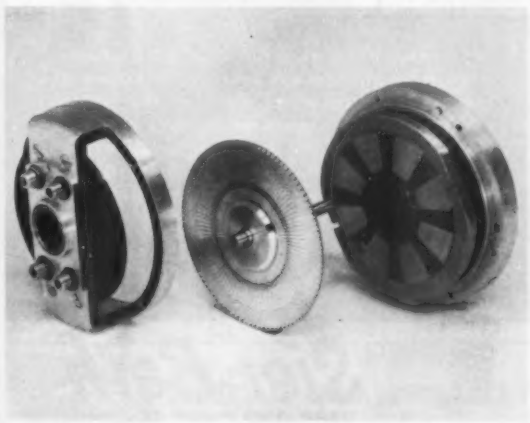

FIGURE 4. Motor with 8 magnetic poles.

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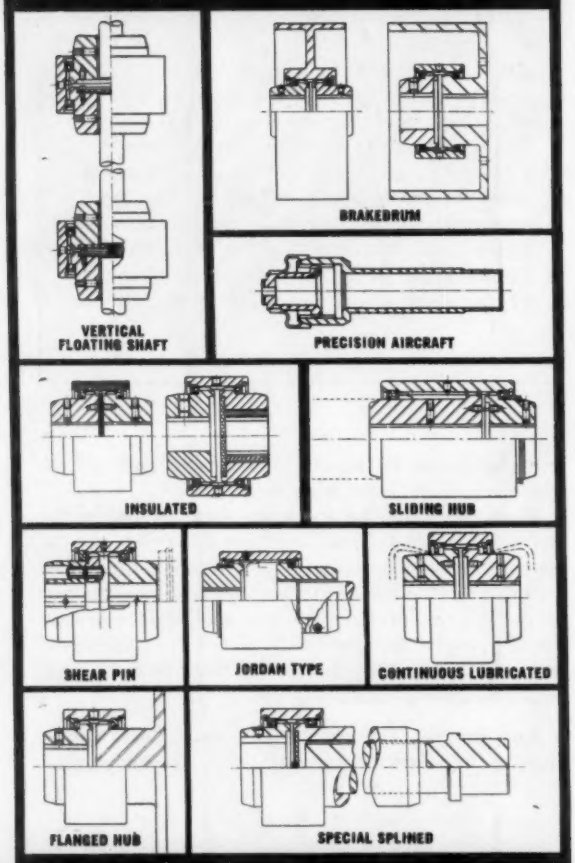


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constant of the motors may be from 20 to 50 milliseconds. Thus, the speed corresponding to a given terminal voltage may be attained 80 to 200 milliseconds after voltage is applied. Special motors may be designed to respond mechanically to inputs within a few thousandths of a second.

**Low inductance.** The armature inductance is low, with a typical value of about 200 microhenries. Therefore, torque appears on the shaft at effectively the same instant that terminal voltage is applied.

**Smooth torque and commutation.** The armature shown in Figure 2 carries 97 conductors. Each one of these conductors is used as a commutator bar. Due to the large effective number of bars, and due also to the fact that no iron rotates in the field, the output torque is smooth and free from cogging. This is a happy circumstance, since, when coupled with the general desirability of running at low speed, it indicates the motor is well suited for direct drive.

**High thermal capacity.** The printed motor possesses good thermal characteristics. The armature conductors are effectively uninsulated and the disc shape is cooled efficiently by radiation to the pole structure and by convection due to the centrifugal blower action of the trapped air in the gap. The 3.5 in. armature design has been subjected to short-duration pulse power inputs of 500 watts without ill effect.

**Power capabilities.** The continuous torque output permissible from the printed motor construction rises at a rate proportional to the $3\frac{1}{2}$ to $4\frac{1}{2}$ power of the armature diameter, depending on cooling provisions. Typical torque values for various machine sizes are plotted in Figure 5.

## Disadvantages

Many problems still stand in the way of bringing this new technique to economical practice. At present, there are four main disadvantages: Large air gap, mechanical precautions, speed limitations, and terminal voltage.

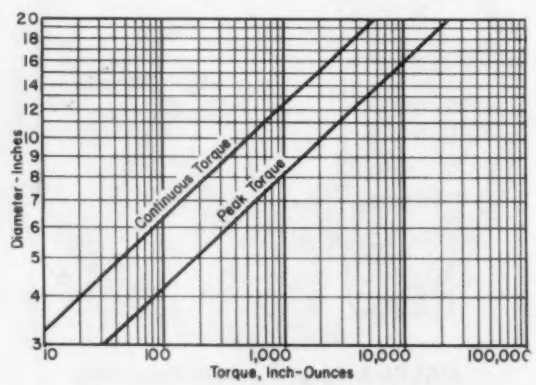


FIGURE 5. Torque values for printed motors.

**Large air gap.** Since the armature contains no iron, this automatically means the magnetic air gap is large when compared to a conventional motor where the copper conductors are immersed in a rotating iron core.

The relatively larger air gap means, among other things, that either more electrical energy or more magnetic material must be used to excite the air gap to a satisfactory flux density. The ultimate cost of the larger air gap is measured either in heating effects or in dollars, depending on which is more significant.

We have little data which may be used for comparison, because the situation is confused by the relative value of the motor's other attributes. For example, the field cost of the motor structure shown in Figures 3 and 4 is around $3.00. Ultimately, the armature is expected to cost about $.50. The sum of these figures plus the remainder of the structure is modest. You must also remember that this inexpensive motor is competitive with high-performance precision servo components.

**Mechanical precautions.** It's harder to avoid distortion in the disc armature. We're trying to get clearances for a disc, rather than a cylinder supported at both ends. End play in the bearings is therefore significant. Furthermore, you must be very careful in selecting the type of material for the disc.

Admittedly, these problems are largely solved when you know in advance that they exist. However, they appear in a different form and to a different degree than in cylindrical motors.

**Speed limitations.** Printed dc armatures are susceptible to eddy-current losses in the copper at high speed. The losses appear as a parasitic drag torque which increases with speed, flux density, and copper thickness. This drag torque is inversely proportional to the square of the number of armature conductors.

These losses are of no practical significance in small motors where efficiency is usually subordinated to low cost. In large motors, the losses generally mean there should be as many armature conductors as possible for operating speeds above 1000 rpm.

**Terminal voltage.** The printed armature is fundamentally a single turn winding, so the motor's operating voltage is low. For armature diameters ranging from 3.5 to 8.5 in., the motor terminal voltage at 3000 rpm will be between 6 and 150 volts. The voltage levels are well suited to power control devices with semiconductors.

In closing this brief summary on the state of the art of the printed circuit motor, we'd like to point out that limits on applications of these motors have yet to be defined. We're working on ac devices, linear motors, new fabricating methods, new materials, and many other developments. It's reasonable to expect that industry will eventually feel the impact of these new ideas. ▲▲▲

*This article was abstracted from a paper presented at the AIEE Machine Tool Conference, Cleveland.*


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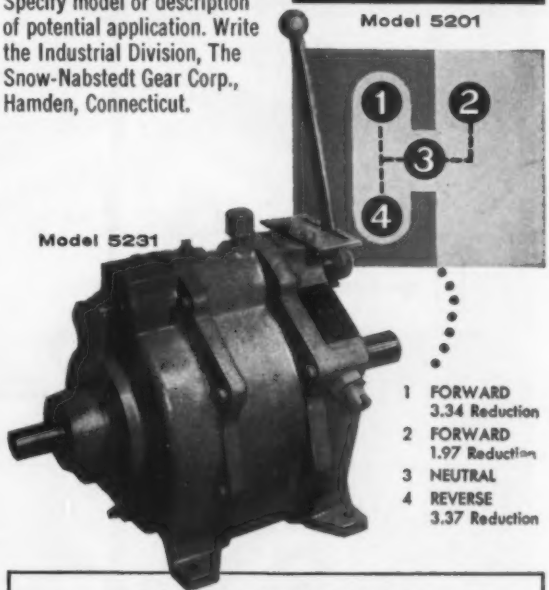


Model 5231

1 FORWARD 3.34 Reduction
2 FORWARD 1.97 Reduction
3 NEUTRAL
4 REVERSE 3.37 Reduction

**SPECIFICATIONS**

| MODEL NO. | 5231 | 5201 | 5108 |
|---|---|---|---|
| Reduction Forward | 1.97:1 & 3.34:1 | 3.16:1 | 3.75:1 |
| Ratio Reverse | 3.37:1 | 3.16:1 | 3.75:1 |
| Power Up To | 28 HP | 28 HP | 8 HP |
| Maximum Input Torque | 1000 in. lbs. | 1000 in. lbs. | 320 in. lbs. |
| Maximum Input Speed | 2400 RPM | 2400 RPM | 2400 RPM |
| Dimensions Long | 15 11/16" | 11 1/2" | 9 1/16" |
| Dimensions Wide | 14" | 12 1/2" | 10" |
| Dimensions High | 14 3/16" | 14 3/16" | 10 5/16" |

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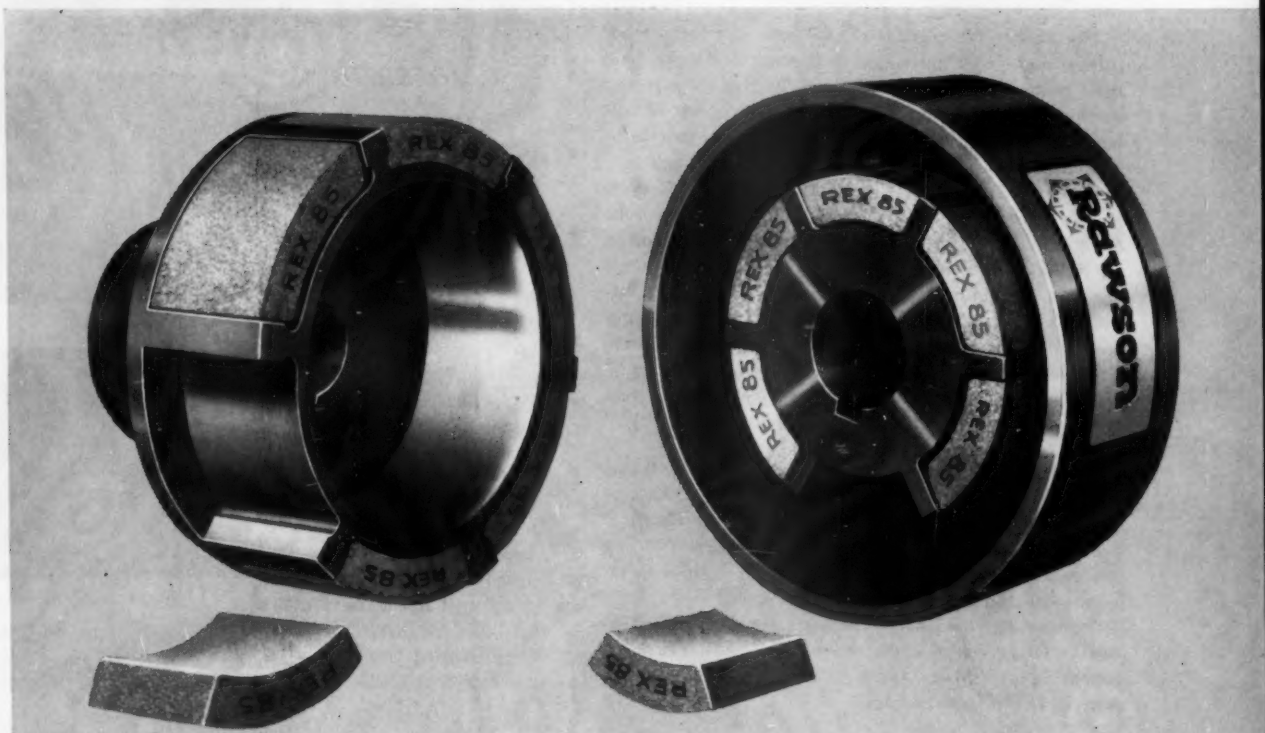


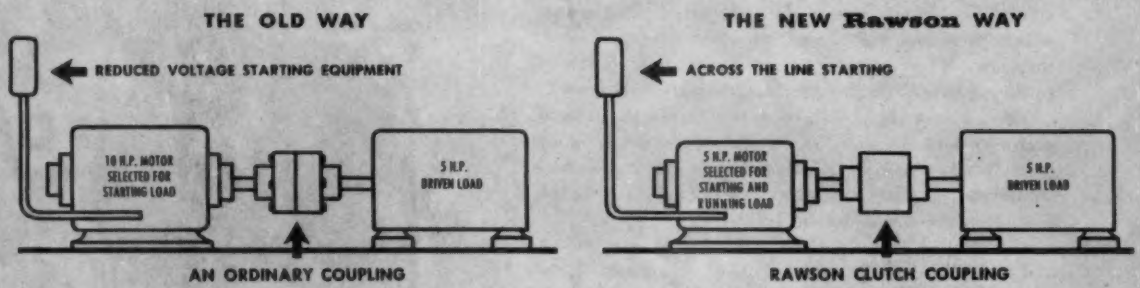
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REDUCED VOLTAGE STARTING EQUIPMENT
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- For power applications up to 2,000 horsepower, drive in either direction.
- Fluid-smooth starting without the power loss of fluid types at full load R.P.M.
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*Results:* "no-load" starting decreases acceleration time and starting current—across-the-line starting can be used instead of costly reduced voltage equipment—based on lower starting load, smaller motors can often be employed—cushioned starting of high inertia loads frequently permits using NEMA B or standard squirrel-cage motors instead of expensive special high-torque motors—delicate equipment is protected by eliminating starting shock—jamming or overloading of driven equipment will cause the clutch to slip, providing protection for motor.

Rawson clutches function as direct-drive clutch-couplings (in-line, shaft-to-shaft connection) or as indirect-drive clutches through V-belts, chains or gearing. They can be furnished with delayed engagement for standby or dual drive installations.

Rawson clutches are simple in design, they never require adjustment, and are entirely mechanical in operation for trouble-free performance. For higher efficiency, lower costs, reduced maintenance and full protection for even the most delicate equipment, specify Rawson centrifugal clutches and clutch-couplings.

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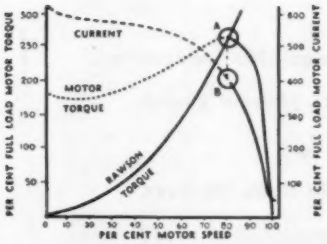


Typical torque and current characteristics of a standard NEMA B motor. Because Rawson clutch does not fully engage until after peak torque speed "A" is reached, motor acceleration time is much faster, peak current period is greatly decreased and motor operates more efficiently "B". Thus, smaller motors and across-the-line starting can be used.

## Rawson Clutches

- **No-load starting reduces motor acceleration time to a fraction of a second.**
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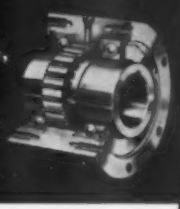

Modern Formsprag over-running clutches are universally used by automotive, aircraft and other industries. They provide greatest torque for size and weight, higher precision and no measurable backlash. Torque capacities range from 50 lbs. in. to 136,500 lbs. ft. Standard bore sizes from ¼" to 12". Our engineering department will design special Formsprag clutches for your unusual applications. Write for your copy of Formsprag catalog.

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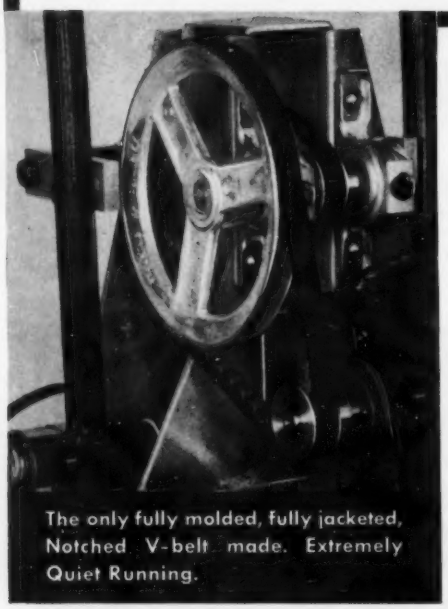

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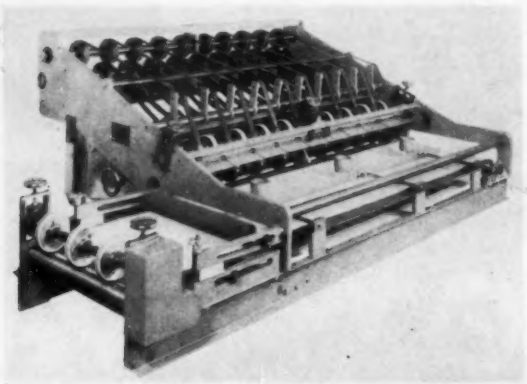
DESIGN
# IDEAS
FROM THE FIELD

## Toothed belts double as conveyor belts

TOOTHED BELTS, well-known for their ability to transmit power, are used to convey paperboard sheets through a collating machine made by Faustel, Inc., Butler, Wis. This collator, installed at Michigan Carton Co., Battle Creek, Mich., is attached to a cutting and creasing machine which perforates and scores cereal boxes printed in sheets.

The collator normally receives 2400 printed sheets an hour from the cutter-creaser, separates them along perforations into strips, then stacks and collates the strips on a slow-down belt conveyor where they are separated into individual cartons, jogged, and stacked.

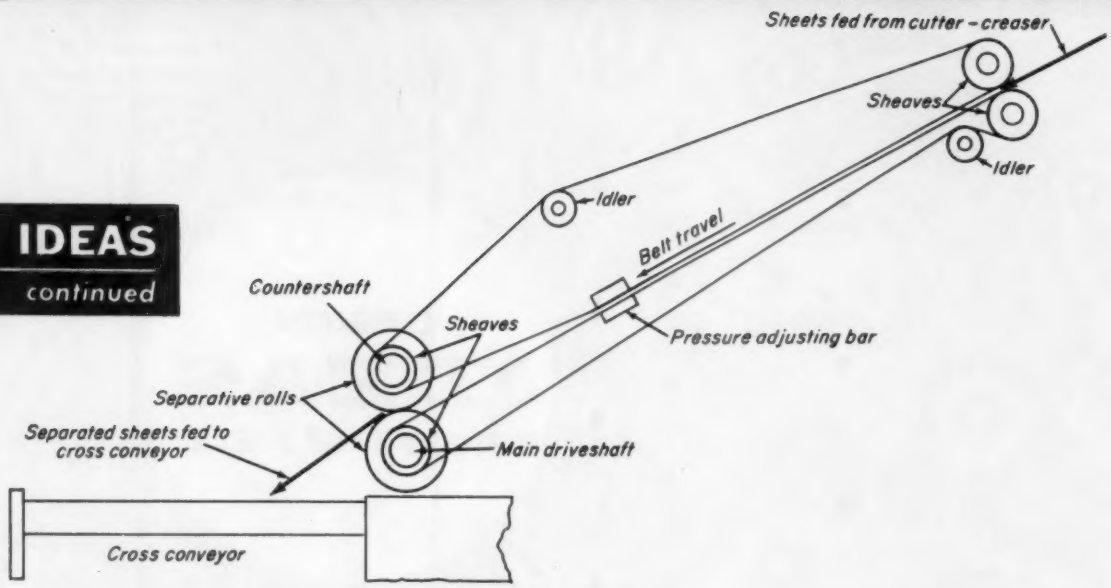


Power from the collator's motor goes through a variable speed drive to a 5:1 speed reducer which turns the driveshaft. The driveshaft, through a 1:1 gear set, drives a countershaft. The driveshaft carries 10 pulleys driving a set of 10 toothed belts. The countershaft also carries 10 pulleys to drive another set of 10 toothed belts.

Each of the 20 belts is 1 in. wide. The sets run parallel, one above the other. The lower set carries the sheets through the collator. The upper belts are a hold-down set, pressed against the sheets by an adjusting bar with a firm, yet gentle, pressure to keep them from slipping. Pressure can be varied by adjusting the bar, which, although it's flat and bears against the toothed sides of the belts, spans enough teeth so there is no vibration.

At the infeed end of the belts, there's about ½ in. space between the sets to admit sheets being fed in. The adjusting bar brings the belts together near the discharge end. Then, at the discharge end, the belts again move apart.

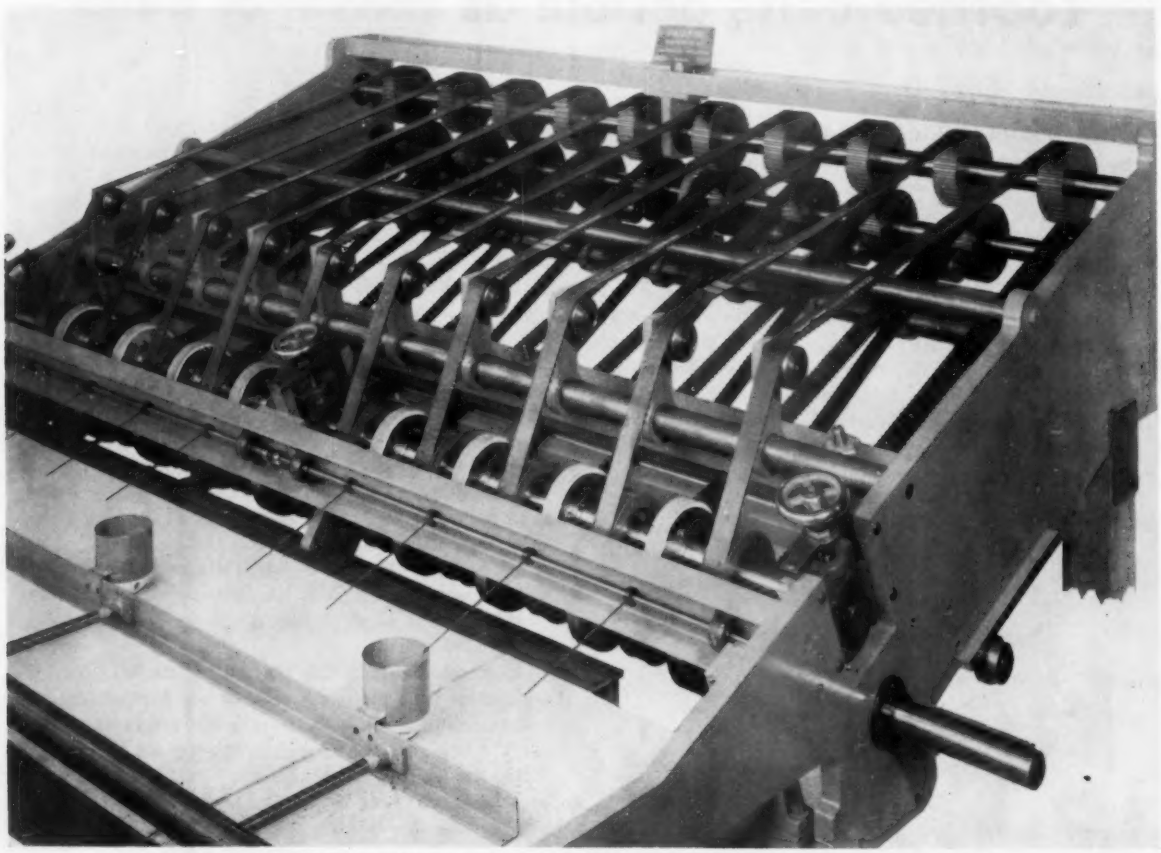
As the sheets reach this point, they are fed between separation rolls mounted on both the driveshaft and countershaft. These rolls are slightly larger than the toothed belt sheaves, so their surface speed is greater. While that part of a sheet behind a perforation is held at a constant speed by the hold-down belts, the part ahead of the perforation is speeded up by the separa-



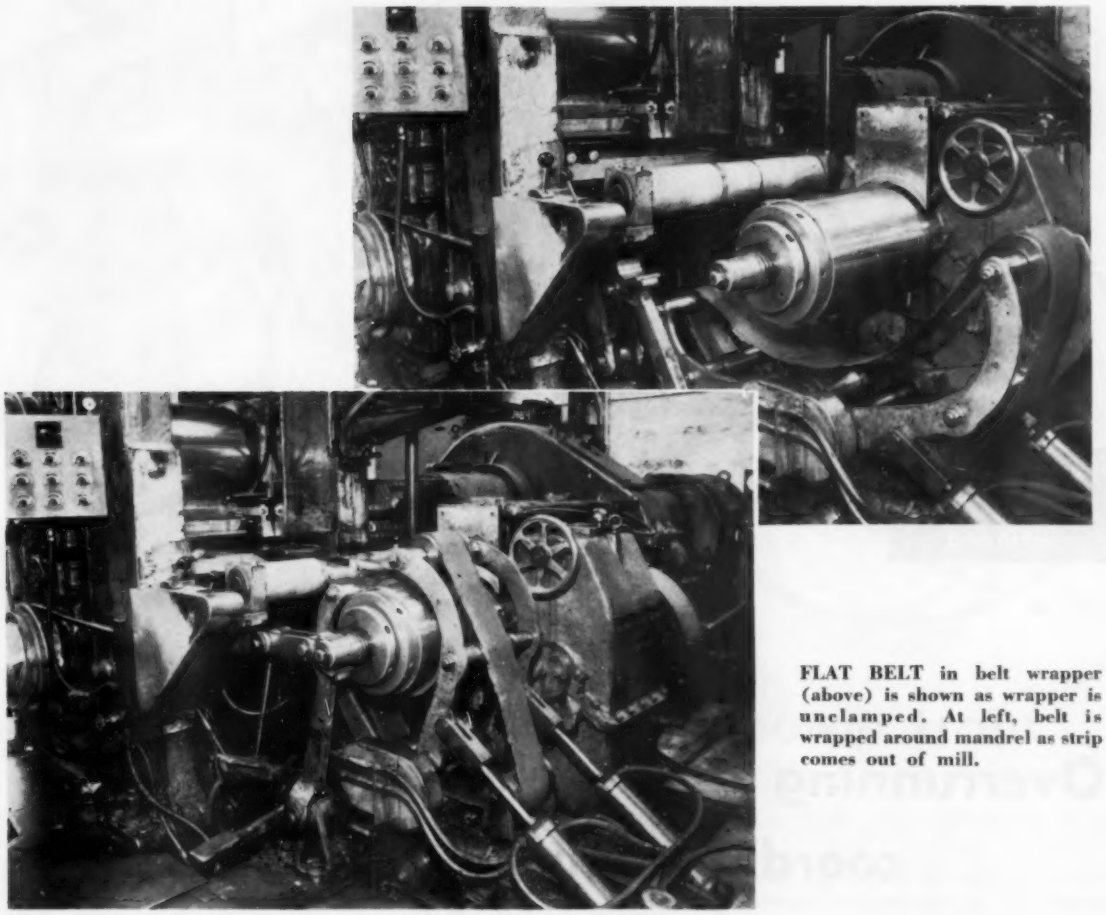

tion rolls. As a result, the sheet is separated into strips.

By using 10 sets of belts, it's possible to distribute holding pressure over the entire width of a sheet. Thus, when it is separated, this is done in a straight line.

The strips of cartons drop onto a standard belt conveyor moving laterally to the toothed belts. This cross conveyor is powered by a right-angle gear box driven off the output end of the driveshaft. At the discharge end of the cross conveyor, the perforated strips are separated into individual cartons by other hold-down and separation rolls. ▲▲▲



**TOOTHED BELTS** are driven by pulleys slightly smaller than separation rolls (center).



**FLAT BELT** in belt wrapper (above) is shown as wrapper is unclamped. At left, belt is wrapped around mandrel as strip comes out of mill.

*Photos courtesy Extremultus, Inc.*

# Polymer belts pass torture test

WANT TO TEST power transmission belts for ruggedness? Install them in a belt wrapper for coiling metal strip and see how long they last. One belt that's almost indestructible in such an installation is a flat elastic polymer belt with leather friction surface.

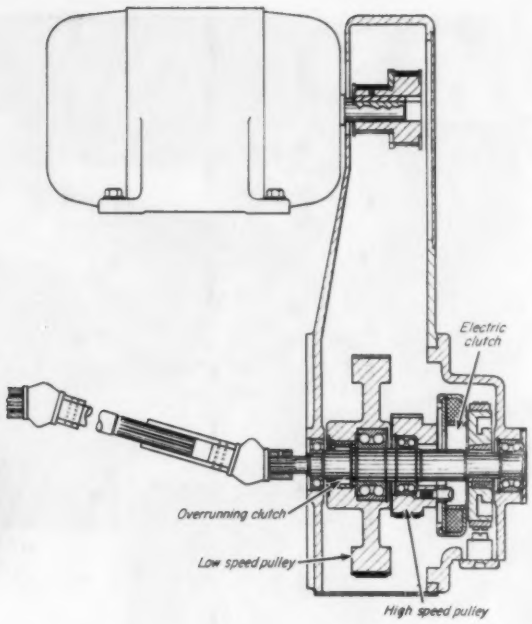
Although it doesn't transmit power in this instance, the belt proves it can absorb severe punishment. It forces metal strip coming out of a mill to start coiling around a mandrel. The strip must be held against the mandrel for a full turn, or until it holds itself in place.

It's like rolling up a sheet of paper. You form a tube, bend your fingers around to hold it, then roll it up. The belt wrapper works just like fingers. The wrapper belt, in a jaw-like frame, is clamped tightly against the mandrel. The strip, fed between the belt and the mandrel, forms a coil. After the first layer is wound, the wrapper is unclamped.

The initial contact of metal against belt is the roughest part of the job. The sharp leading edge of the strip, moving straight forward, slices into the belt as it's angled down and around. That's why, on one application coiling aluminum, the belts originally installed had to be replaced more than one a week. They'd shred, and pieces of belting sometimes got wound inside a coil, ruining it.

The leather surface elastic polymer belts don't shred and do not stretch. In fact, after more than 12 weeks' use, they showed little wear and did not require shortening. In addition to the obvious savings in replacement belt costs, much production time is gained by cutting the downtime for changing belts. Furthermore, the original belts could only wrap strip less than .150 in. thick. The polymer belts can handle .200-in. 5052 aluminum. ▲▲▲

**IDEAS**
*continued*




# Overrunning clutch, electric clutch coordinate multi-speed belt drive

IMPROVED DRIVE DESIGN on the *Burgmaster* turret drilling machines includes a positive, totally-enclosed, 4-speed belt drive which basically consists of two parallel sets of pulleys.

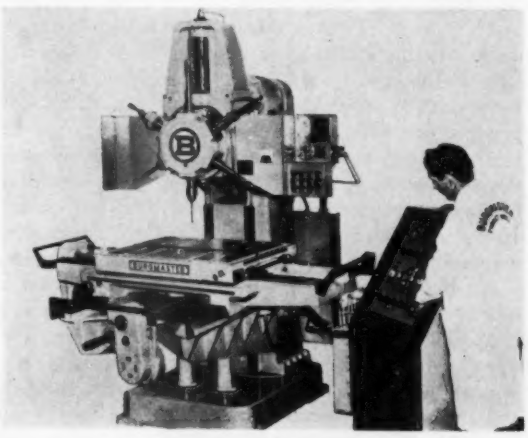
This drive has an electric clutch to engage the high-speed pulleys. When the electric clutch is disengaged, an overrunning roller clutch picks up the low-speed pulleys. The standard drive has a 2-speed motor, thus giving 4-speed power transmission to the spindles.

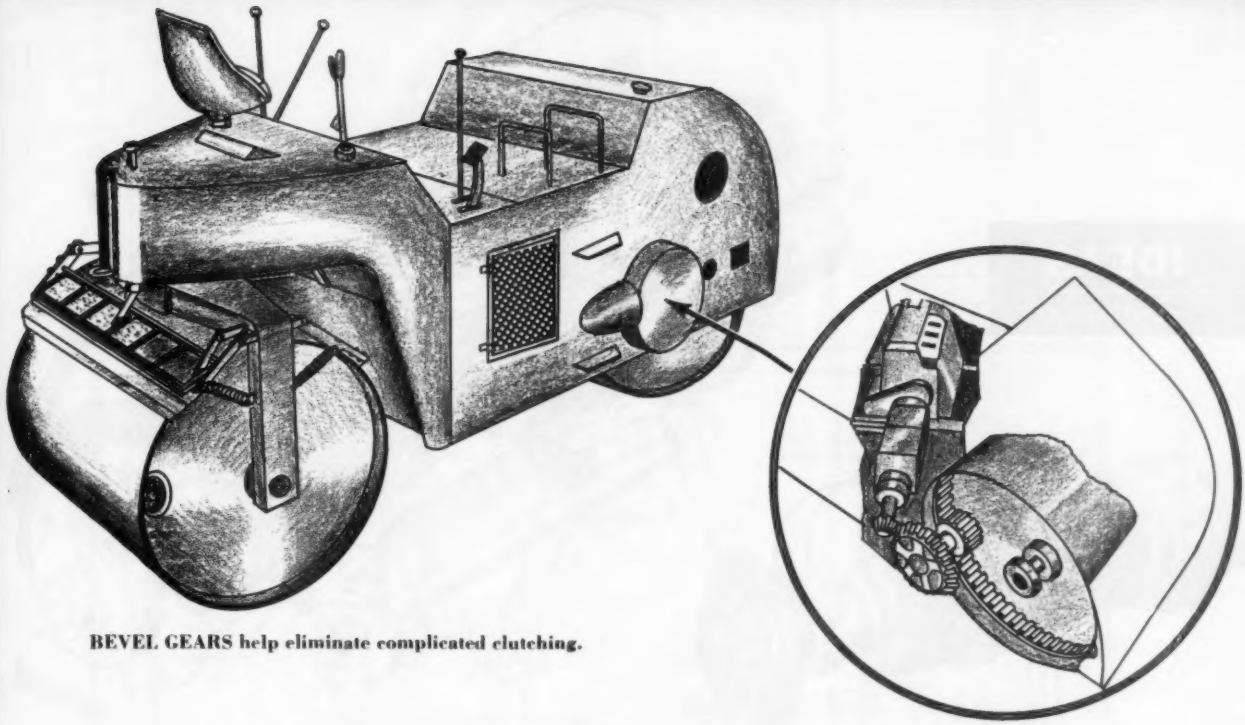
The turret has either 6 or 8 machining spindles, depending on the model. Gear ratios of the individual spindles normally varied in 3 speed ranges. This, coupled with the 4-speed drive, provides 12 spindle speeds. An optional 4-speed drive motor doubles the number of spindle speeds to 24.

Spindle speeds are dial set on the control panel. For each spindle station on the machine turret, there's a corresponding knob on the control panel which signals the desired speed setting when a spindle is in the work position. This control is through limit switches that are cammed through mechanical linkage to the indexing motion of the turret.

The machine turret, in automatic hydraulic and tape-controlled models, feeds hydraulically and permits infinitely-variable preselective settings. Improvements in this system automatically compensate for pressure and temperature variations, assuring constant-positive feed.

Manufacturer of the drilling machine is Burg Tool Mfg. Co., Inc., Gardena, Calif. ▲▲▲





**BEVEL GEARS help eliminate complicated clutching.**

# Diagonal drive simplifies power train

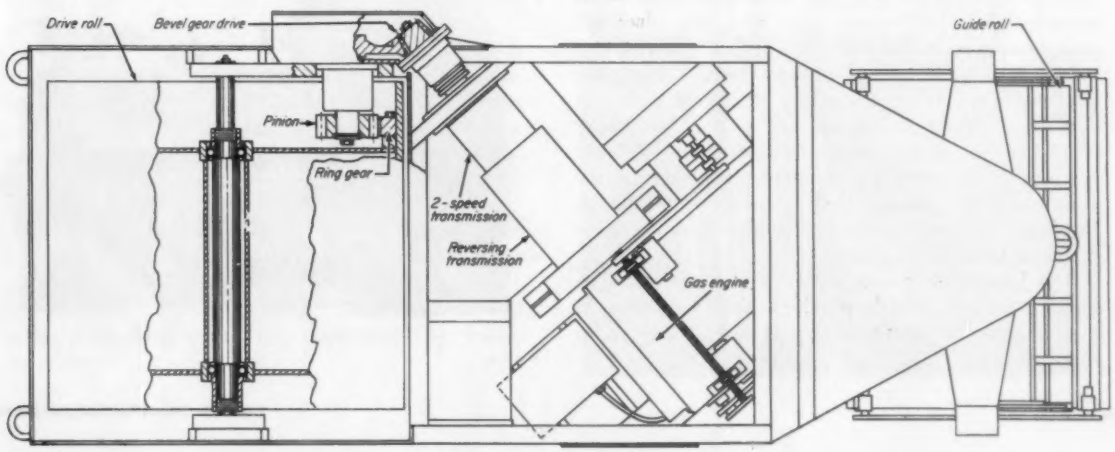
POWER goes straight to work without high-loss mechanical detours in a drive developed by American-Marietta Co., Construction Equipment Div., Milwaukee.

The drive is used in the *Amrol*, a steel-wheel roller for finished compaction of roads and other paved areas. The roller also is used to compact subbase, base course, gravel, bituminous, and hot asphalt; and for salt, cement, lime, and fly ash stabilization. It has two rolls, one drive and one guide, which may be filled with ballast.

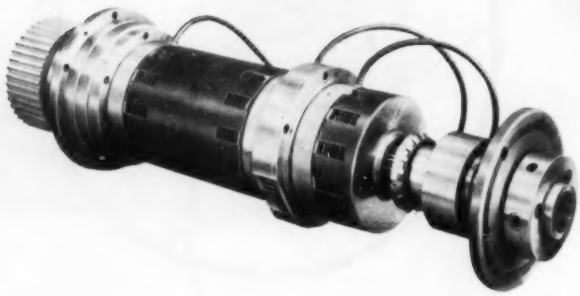
To simplify the power train, the main drive components are set diagonally between the rolls. The engine, torque converter, reversing transmission, and 2-speed transmission are set at about a 45° angle to the line of travel. This eliminates one 90° turn through complicated clutching and another 90° turn to drive the roller.

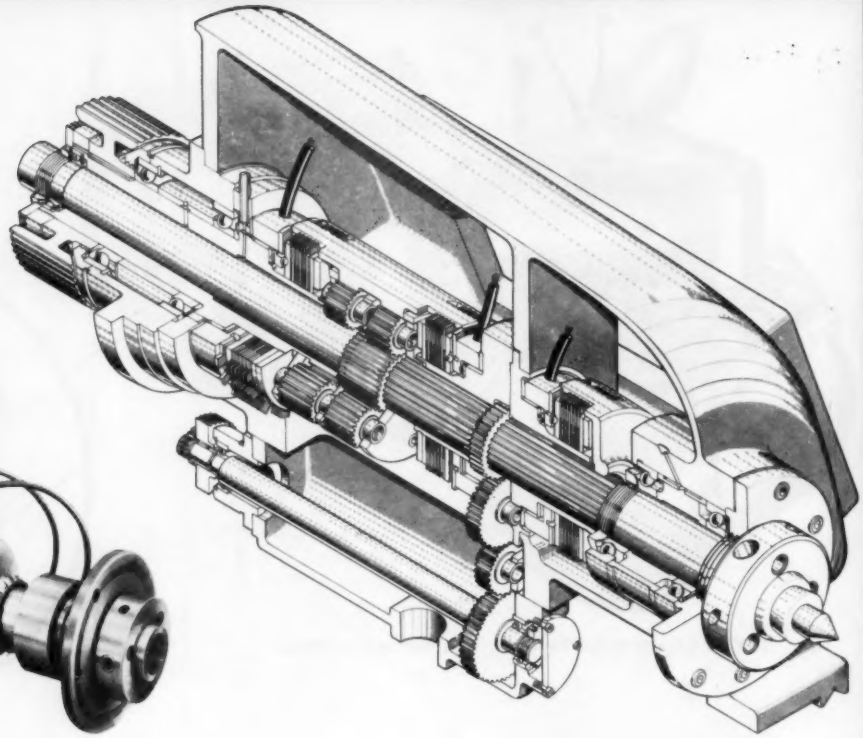
Power flows from the engine through the torque converter and reversing transmission to the 2-speed transmission, which is flexible-coupled to a bevel gear drive. This comparatively simple bevel gear drive provides the direct route to the drive roll. The bevel pinion and gear work at a 45° angle, with the bevel gear driving directly to a 12-tooth pinion which drives a large ring drive gear bolted to the side plate of the drive roll.

This simplified system gives positive power. Shocks and wheel-slipping starts are eliminated by the torque converter, which matches power and speed to the job. The engine is a gasoline developing 73 hp. Road speed of the Amrol is 1.5 to 5.5 mph. ▲▲▲



**IDEAS**
*continued*





# Coaxial headstock delivers top horsepower, smoothness

A NEW COAXIAL headstock on the *Micro-Turn* lathe delivers maximum horsepower and smoothness at infinitely variable spindle speeds from 43 to 3500 rpm. Variable speeds are provided by a mechanical speed variator driven by an ac motor.

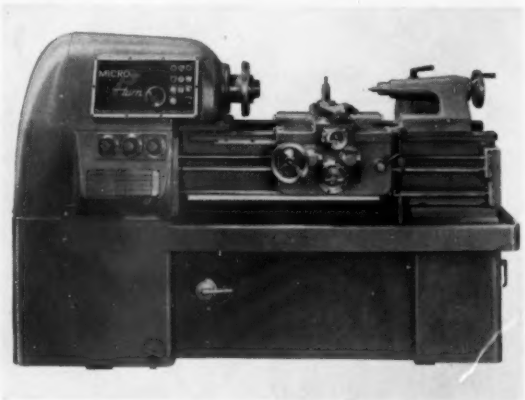
Since the drive gives constant horsepower through the entire speed range, high torque is insured at low speeds for heavy cutting. A built-in torque-responsive mechanism prevents slippage under starting or shock loads, while the vibration-free drive assures a fine finish and improves tool life.

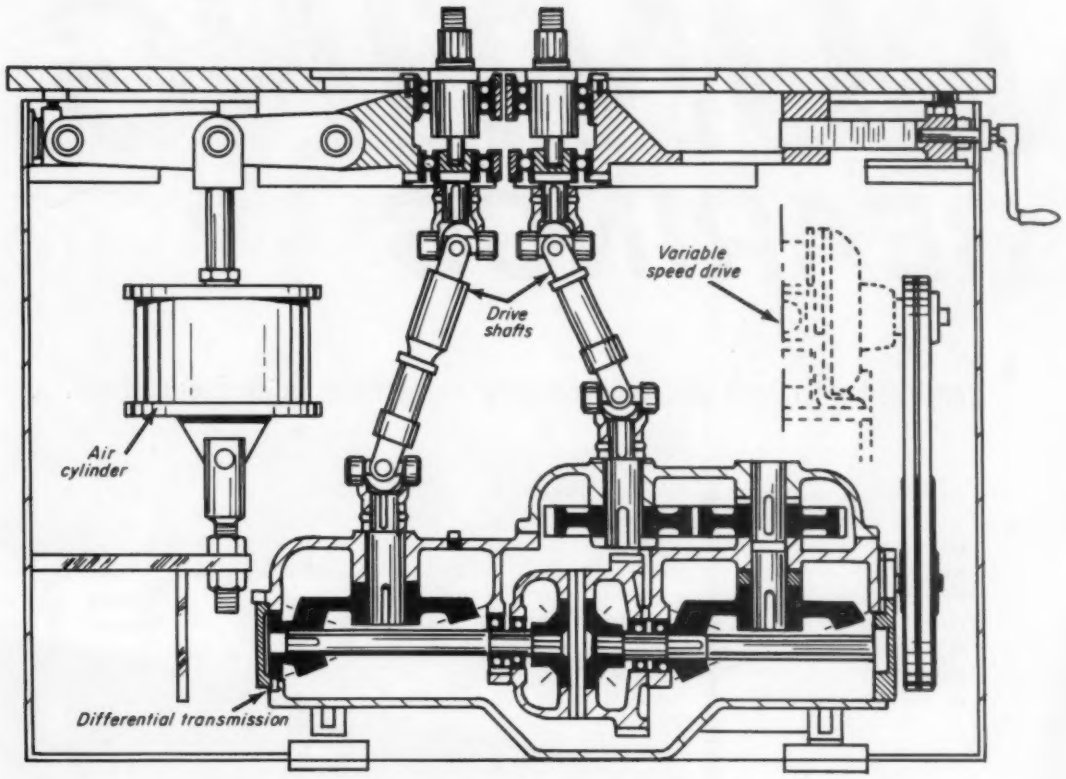
The headstock is designed around a single shaft surrounded by a floating type ring and planetary gear arrangement. Inherent benefits are: Low inertia effect for quicker acceleration and deceleration, prolonging clutch and brake life; simplified alignment further aided by a self-centering effect; and fewer revolving parts for greater smoothness and efficiency of power transmission. Minimum vibration of the transmission is complemented by mounting the spindle on three pre-loaded precision bearings that never require adjustment.

The headstock is composed of two sections. The back gear unit, which provides high reduction in minimum space, operates only at low speeds up to 400 rpm. For high speeds above 400 rpm, the coaxial sections lock into a single unit. The lathe then operates without gearing or adjustable belts, directly from main drive to spindle.

Switch between high and low ranges can be made without stopping. The electric clutches never have to be adjusted.

Manufacturer: Nebel Machine Tool Corp., Cincinnati, Ohio. ▲▲▲






# Differential synchronizes work, tool speeds

THE BEATTY-QUICKWORK stamping trimmer, which can shear mild steel stampings up to 3/16 in. thick, can be adapted to trim rectangular or odd-shaped stampings with inside corner radii as low as 3/8 in. To work effectively, rotation of the tool must match that of the work piece.

The machine is driven by a variable-speed drive with step cone pulleys giving a choice of three speeds. The drive powers two vertical spindles through a transmission which employs a differential. The differential provides identical surface speed at either spindle, compensating for differences in diameters of the work and the tool.

One of the spindles is movable in a horizontal plane by an air or hydraulic cylinder. The other spindle, on which the piece part is mounted, is manually adjustable in a horizontal plane by a lead screw.

Beatty Machine & Mfg. Co., Hammond, Ind., makes the trimmer. ▲▲▲

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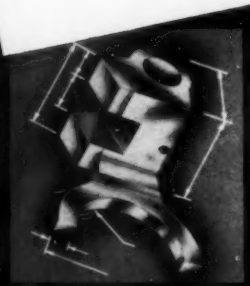
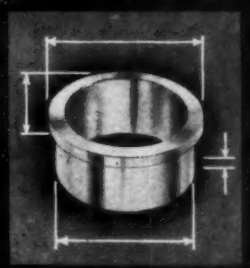
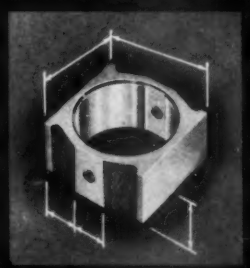
## ...case in point*



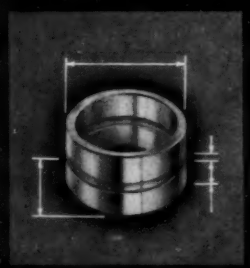
*Clearly evident is the economy in the production of this shifter fork by Bunting Powder Metallurgy. The elimination of machine work effects striking cost reduction.



*This cylinder gland bearing made of Bunting Bearing Aluminum is an example of how to save weight and money on the cost of large, thick-wall bearings and parts.



*This cast bronze cam block, made to unusually close limits with very fine finish, is absolutely round and true to size with cost at a feasible figure.



*Solid cast aluminum gear bearing to replace roller bearing for longer life and lower cost.

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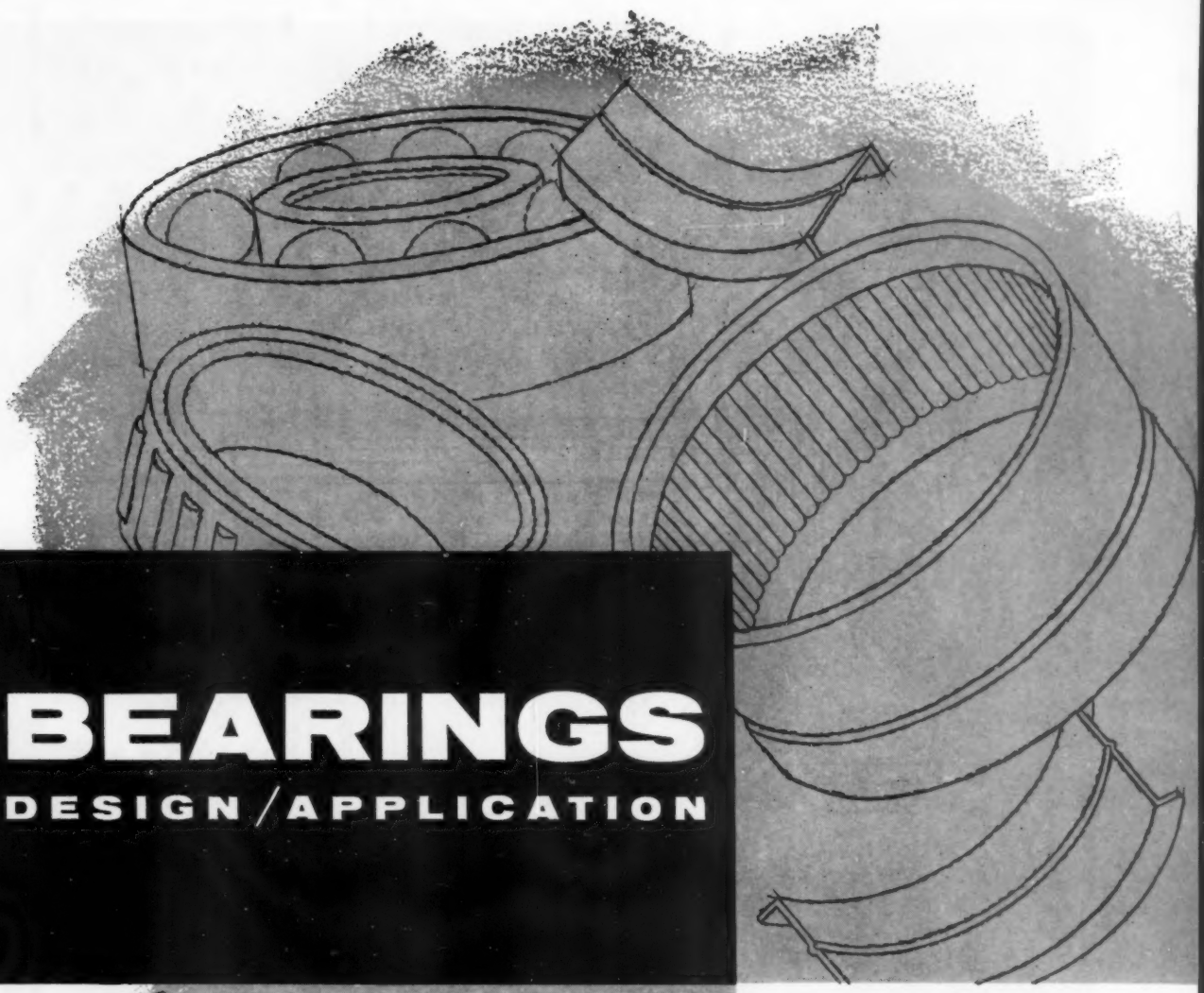
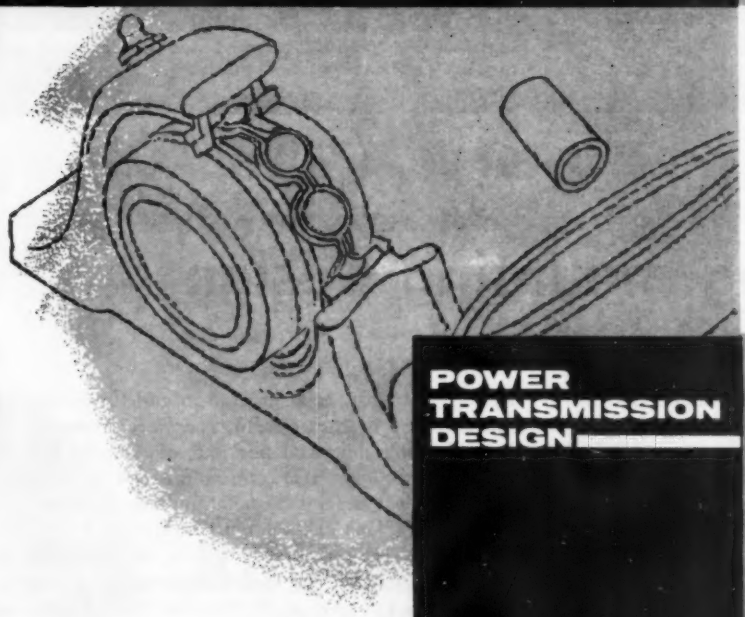


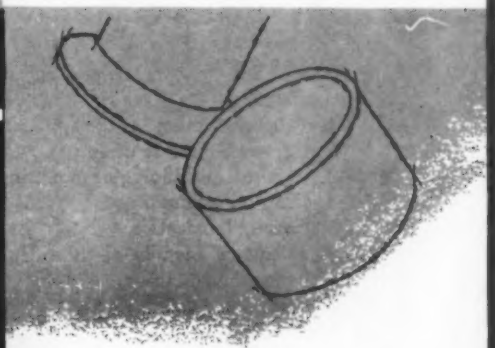
# BEARINGS

## DESIGN/APPLICATION



**REGULAR MONTHLY SECTION OF IDEAS AND DEVELOPMENTS**

**POWER TRANSMISSION DESIGN**



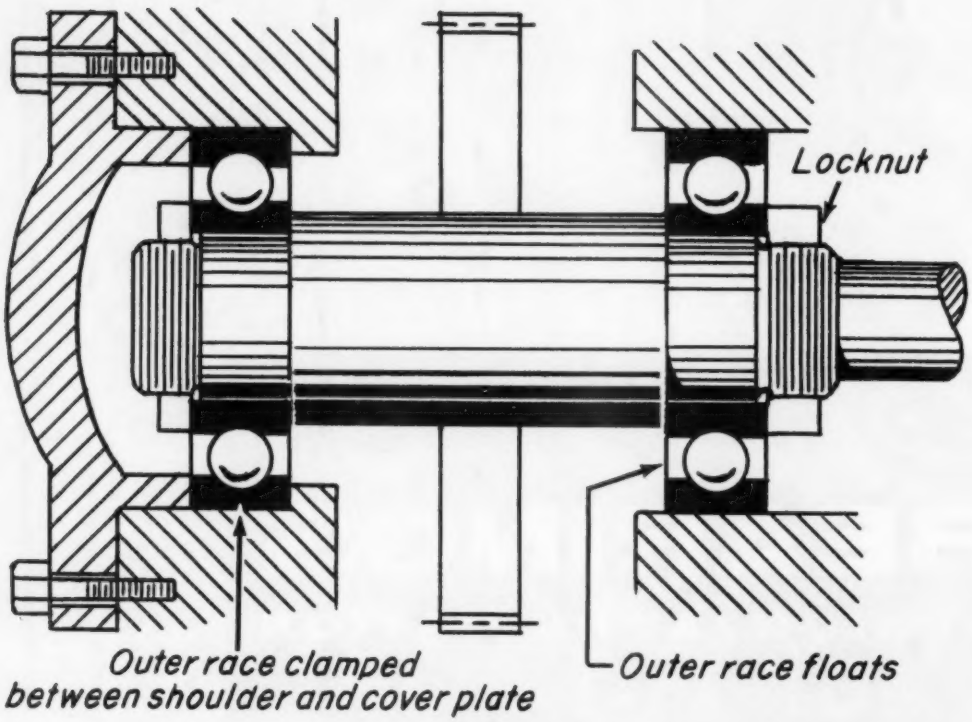



**FIGURE 1. Typical bearing installation has both bearings pressed on shaft. Outer races are slip fit in housing, but one outer race is kept from moving axially. Other outer race floats (can move in either direction axially) to prevent excessive axial loads on both bearings due to differential thermal expansion of shaft and housing or accumulation of tolerances.**

**Some fundamentals of . . .**

# Bearing mounting design

SUCCESSFUL operation of an antifriction bearing depends on:

1. Proper selection for the application
2. Correct mounting design
3. Accurate machining of mounting surfaces
4. Proper installation
5. Correct lubrication
6. Adequate sealing of lubricant and protection from contamination.

This article will discuss points two and three—design and accuracy of the mounting surfaces. However, it doesn't matter how well this part of the job is done if the other points are ignored. There'll be trouble.

In a typical bearing installation, Fig. 1, there are two bearings. One of these must be fixed for accurate axial positioning of the gear, sheave, etc. mounted on the shaft. After all, one of the important functions of a bearing is to locate or fix the shaft and whatever is

Bearing at left has 1.75″ bore, while tandem bearing in main illustration has 17.0″ bore. *Yet both are standard, cataloged items.*

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mounted on it so there is no radial or axial movement, within close limits. The other bearing should float.

Float means that the inner ring is fixed axially to the shaft but the outer ring is free to move axially in the housing. This is necessary to prevent excessive axial or thrust loads on the bearings from things like shaft expansion or a combination of housing and shaft tolerances which will cramp the bearings. In general, it's best to fix the bearing at the drive end of a shaft. However, because the fixed bearing must carry the thrust loads, it may be better to fix the other bearing. This depends on the radial loads of the two bearings. If radial loading is low on the bearing not at the drive end, fixing it so it carries the thrust will tend to equalize the bearing loads.

When helical gears are used, only one bearing on the pair of shafts can be held or cramping can result. Shape of the gear teeth will produce cramping unless one of the gears can float to the position dictated by the teeth in mesh.

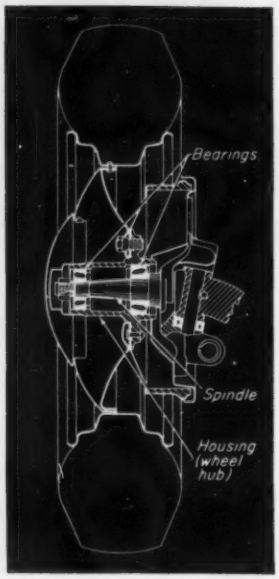



**FIGURE 2. Where the shaft (spindle) is stationary and the housing rotates, as in automobile front wheel bearings, inner bearing race should have a slip fit on the shaft, outer race, a press fit in the housing.**

## Shaft and Housing Fits

To prevent uncontrolled creeping or slip, the bearing ring which contacts the rotating part of a shaft-bearing-housing assembly must have an interference fit. The ring which contacts the stationary part may have a slip fit. The slip fit of one ring greatly simplifies installation and prolongs bearing life by allowing that ring to creep at a slow, harmless rate so the load is not always applied to the same point on the ring.

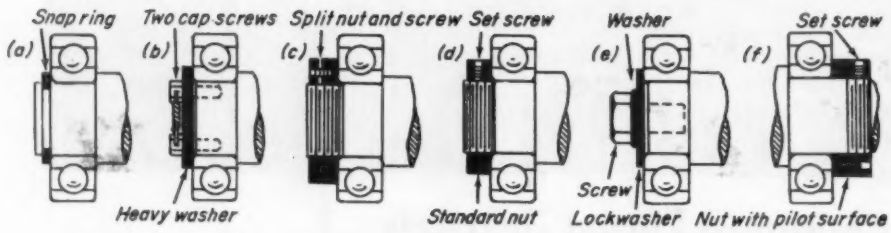



**FIGURE 3. Some typical ways to hold inner bearing rings in position axially. Snap rings are not recommended for heavy thrust loads. Methods (*b*) and (*e*) are only suitable for use at the end of a shaft.**

In most applications, the shaft rotates, housing is stationary, and the load is constant in direction. Therefore, the inner ring must be a press fit on the shaft and the outer ring will have the slip fit.

Where the housing is the rotating part and the shaft or spindle is stationary, procedure is the opposite. Then, the outer ring must be a press fit in the housing and the inner ring a slip fit on the shaft. Front wheel bearings of automobiles are a familiar example of such a case, Fig. 2.

There are two other types of conditions, not so often encountered, where the load rotates. One of these is the connecting rod bearing. In this case, the inner ring should be a press fit and the outer ring a snug fit. The second case is exemplified by a vibrating

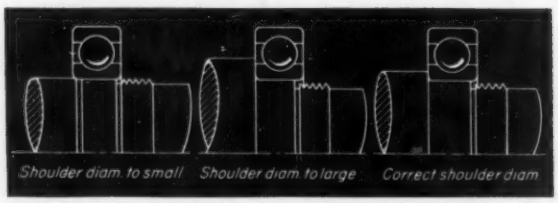



**FIGURE 4. Shaft shoulders must be of correct height. Too low a shoulder does not accurately position the bearing. Too high a shoulder may interfere with lubrication or the rolling element spacer.**

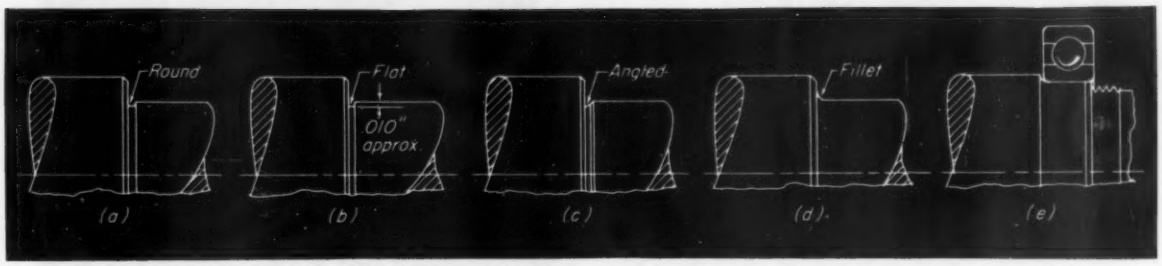



**FIGURE 5. Shafts must be undercut or have a fillet to let the bearing inner ring seat solidly against a shoulder. Too large a fillet radius will keep the ring from seating properly. (e).**

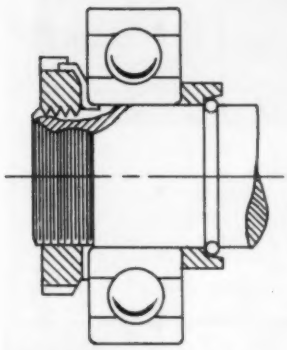


**FIGURE 6. Where shaft diameter cannot be great enough to give sufficient shoulder, a shoulder ring retained by a snap ring can be used.**

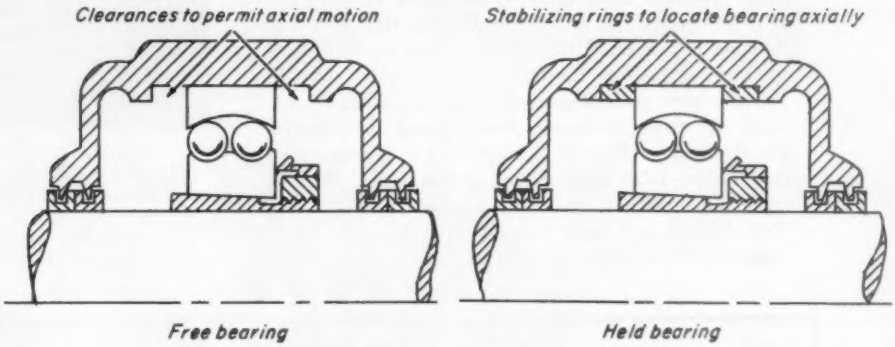



**FIGURE 7. Tapered adapter sleeve used with a tapered bore bearing locks the bearing securely to the shaft without pressing or shaft shoulder.**

screen. Here the outer ring is critical. It must have a press fit in the housing.

Amount of looseness or tightness (interference) to use varies with both the size of the bearing rings and the load. Bearing manufacturers have prepared extensive tables covering recommended fits for all sizes of bearings, under the different loading conditions, and different degrees of load. These tables should be consulted. But, the information they contain must often be modified either based on experience or just plain common sense. For example, loads on identical bearings on the same shaft may vary considerably, but it would be foolish to machine the shaft to a slightly smaller diameter where the bearing with the lighter load is mounted.

## Axial Positioning and Locking

For lightly loaded bearings, interference fit of the ring may be enough to hold the bearing in position after it's installed. And, it's possible that the initial position could be established by careful measurements during assembly. This would certainly be the most economical way to mount the bearing from the standpoint of cost of shaft and bearing. But, even though the press fit is often relied on to maintain position, it's good practice to provide some more positive way of positioning. Shaft shoulders are the most widely used method of doing this. A snap ring in a groove in the shaft may serve as a shoulder where loads are light. Snap rings may also be used to hold a bearing in position against a shoulder where thrust load against the snap ring is not too high.

Shaft machining is simplified by using snap rings, but it should be remembered that the snap ring groove weakens the shaft. The snap ring groove does not, however, weaken the shaft to any greater degree than would an undercut used when the shaft is threaded for a locknut.

With most larger bearings and where a bearing must absorb thrust loads in both directions, a locknut and lockwasher are used to hold the bearing securely against the shaft shoulder.

Shaft shoulders must be square with the shaft, of correct height, Fig. 4, and there must be an undercut or fillet of correct radius to allow the bearing to seat properly against the shoulder, Figure 5. In cases where the maximum shaft diameter cannot be large enough to give sufficient shoulder height, a shoulder ring can be used, Figure 6.

Another method for mounting bearings is with a tapered adapter sleeve, Fig. 7. This is used with tapered bore bearings and allows a tight fit on a shaft without pressing. A locknut draws the bearing up on

the tapered sleeve to clamp the sleeve on the shaft and provide the equivalent of a press fit. An advantage of this method is that shaft tolerances need not be so close to give the required fit. On the other hand, greater care is required during assembly for two reasons. First is that axial position of the bearing is determined by measurements made during assembly. Second, the inner ring of the bearing is expanded during tightening and excessive tightening may reduce the internal bearing clearance to a point where the bearing will be tight.

There are some special inner ring designs to facilitate locking a bearing to the shaft, Fig. 8. These include extended inner rings which fasten to the shaft with set screws and an extended inner ring which is clamped by an eccentric locking collar acting on an eccentric surface on the end of the ring.

Outer race positioning and clamping methods are much like those discussed. Some typical installations are sketched in Figure 9. Some of the special outer race designs to simplify mounting design are: flanged types and those with snap ring grooves in outer races. Both flanges and snap ring grooves in outer races eliminate the need to machine shoulders in housing.

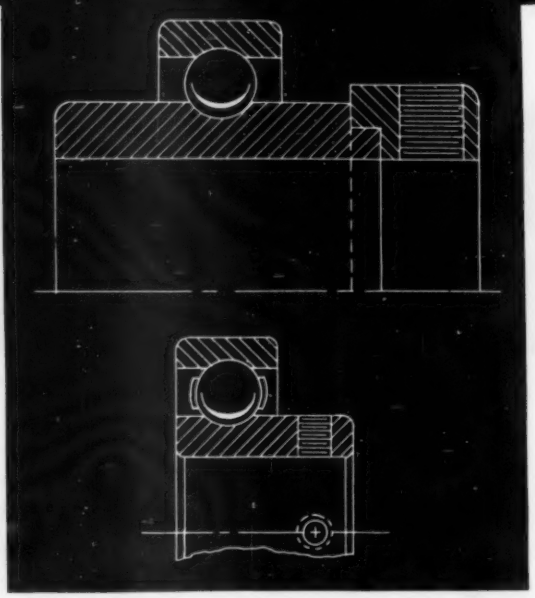


**FIGURE 8. Special inner ring designs facilitate locking bearings to shafts. Eccentric groove on OD of inner ring and ID of collar tighten the inner ring on the shaft when the collar is rotated, top. Extended inner ring, bottom, is locked to the shaft with set screws.**

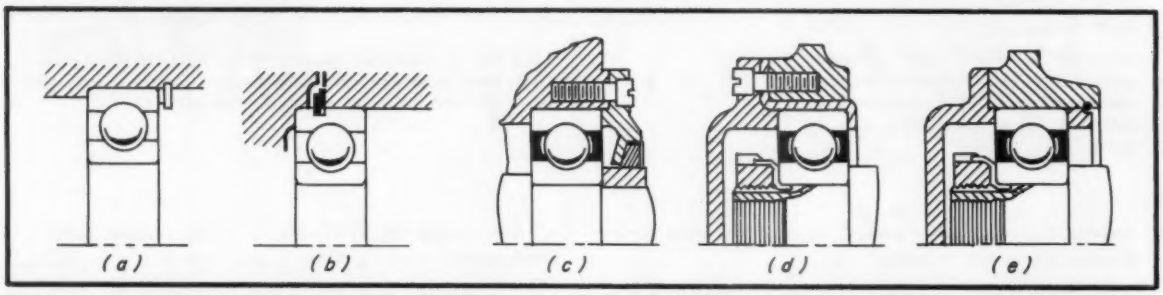



**FIGURE 9. Some typical ways to hold outer bearing rings in position axially. Designs (*b*), (*d*), and (*e*) let the housing be bored straight through without a shoulder. Adapter sleeve, (*d*), may be a casting or pressed metal.**

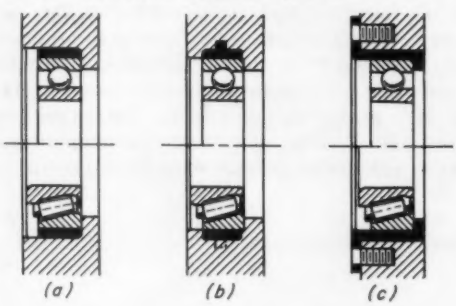
## Housings

When housings are soft metal or metal with a coefficient of thermal expansion noticeably greater than that of the steel from which the bearings are made, there are a few special precautions. The usual press fit will not be sufficient to hold the outer race in place if the housing expands at a much more rapid rate than the bearing.

There are two ways to solve this problem. One is to increase the amount of interference when the bearing is installed. Interferences of 0.00025 to 0.0005 in./in. OD for ball bearing outer rings and 0.001 in./in. OD for tapered roller bearings are usual. When using these fits, you must be sure you start with a bearing with enough internal looseness. Also, the housing metal must be hard enough so it won't pound out under operating loads. And, it's a good idea to clamp the outer ring firmly against a shoulder to help hold it in place.

Second approach is to use a steel liner in the bearing bore. Thickness of the liner should be 0.7 times (bearing OD)$^{1/2}$. The liners must be firmly anchored to the housing to keep them from turning. Liners can be pressed-in, cast-in, or bolted to the face of the housing, Fig. 10. When pressed-in, interference should be 0.001 in./in. liner diam., and the liner bore should be finish machined after pressing. ▲▲▲

**FIGURE 10. Bearing bore liners may be *a* pressed-in, *b* cast-in, or *c* bolted to the face of the housing. They prevent excessive creep and pounding out of the housing due to differential thermal expansion.**



# Gates High Capacity Drive on Blower for Eli Lilly

## SAVED { 6⅞" in face width
97 lbs. in drive weight
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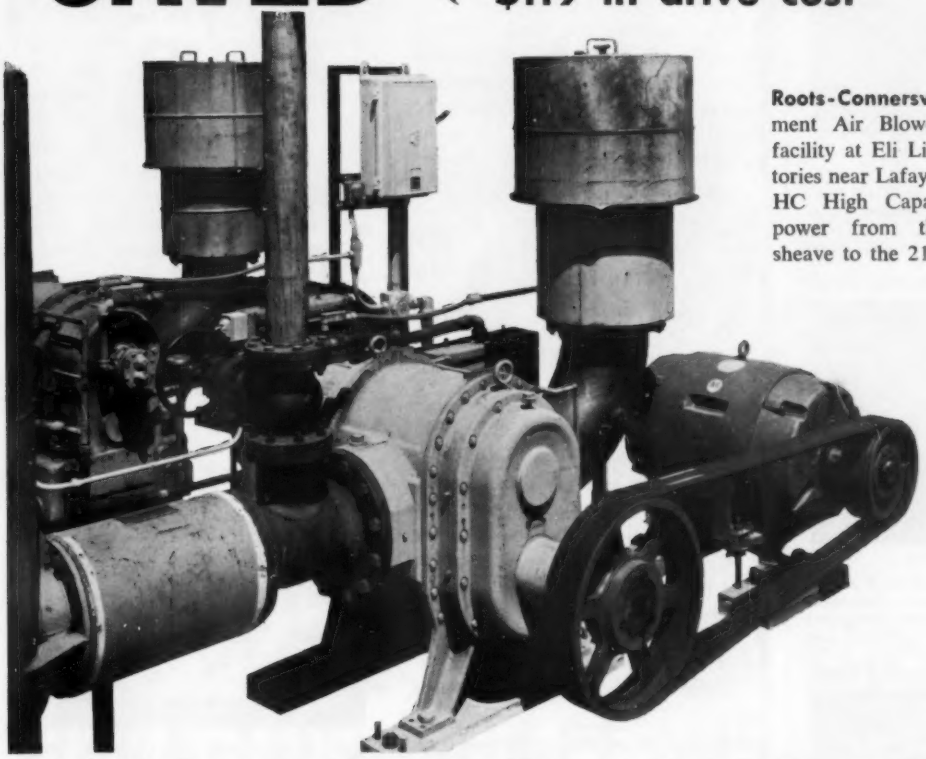

**Roots-Connersville** Positive-Displacement Air Blower on waste-treatment facility at Eli Lilly Company's Laboratories near Lafayette, Indiana. Six Super HC High Capacity V-Belts transmit power from the 13.2-inch DriveR sheave to the 21.2-inch DriveN.

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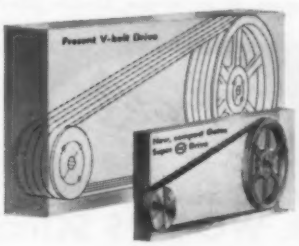
**The Gates Rubber Company,** Denver, Colorado
**Gates Rubber of Canada Ltd.,** Brantford, Ontario




Gates *World's Largest Maker of V-Belts*

# Gates Super HC HIGH CAPACITY V-Belt Drives

same hp capacity in smaller "package"

Circle No. 26 on Reader Service Card

# WOOD'S POWER TRANSMISSION PRODUCT NEWS

NEW, NON-FREEZING VARIABLE

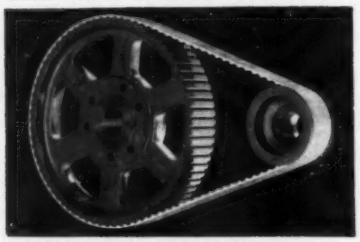
Wood's new "SVS" stationary control, variable speed drive has positive locking collars and other, patented features which eliminate freezing, assure easy speed change. No lubrication is required. Uses standard v-belts and stock companion sheaves. Write for Bulletin 6102.

**Circle No. 59 on Reader Service Card**

NEW, TREMENDOUS SAVINGS

Wood's new Ultra-V Drives handle up to 3 times more horsepower than conventional v-belt drives in a given space . . . reduce overall drive dimensions as much as 50% . . . cut weight up to 25% and costs up to 30%. Write for Bulletin 9102.

**Circle No. 60 on Reader Service Card**



POSITIVE ACTION—LONG LIFE

Wood's Timing Belt Drives provide positive, slip-free action. Belts are all muscle. No high initial tension, tension devices or lubrication needed. Drives are light weight, compact . . . quiet and clean. Wide load and speed range. Equipped with famous Sure-Grip Bushings. Write for Bulletin 2100.

**Circle No. 61 on Reader Service Card**

MP/3608

Woods

**T. B. WOOD'S SONS COMPANY**

CHAMBERSBURG, PENNSYLVANIA

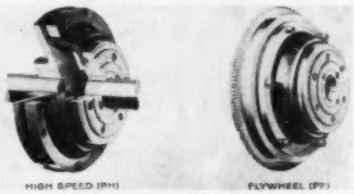
ATLANTA • CAMBRIDGE • CHICAGO
CLEVELAND • DALLAS


# NEW PRODUCTS

**To get complete information on these products, use the Reader Service Cards bound into this issue.**

## Flexible cushion couplings

A pan-shaped rubber flexing element is the new design feature of two cushion-type couplings for high speed or high torque applications. In the Para-flex High Speed coupling (for speeds to 5320 rpm), the flexible member



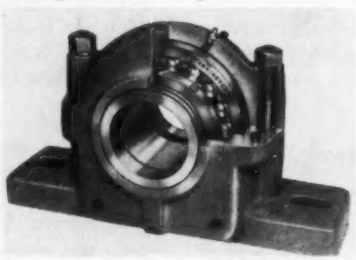

is supported on one side by a clamp-ring flange with its larger side bolted to a taper-bushed steel disc. The Para-flex Flywheel type bolts directly to the fly wheel of the driving engine. Sizes to fit bolt circles of most SAE flywheels to 19¼ in. diameter. Both couplings come in sizes to deliver up to 47 hp per 100 rpm, with Taper-Lock bushings to fit shafts to 4 in. diameter. Hubs can be bored to order to fit larger shafts.

*Dodge Mfg. Corp.*, Mishawaka, Ind.

**Circle No. 200 on Reader Service Card**

## Heavy duty pillow blocks

Pillow blocks with self-aligning spherical roller bearings in split housings come in two series covering 143 sizes—Series SAF, with two cap bolts, and Series SDAF, with heavier castings and four cap bolts. All sizes



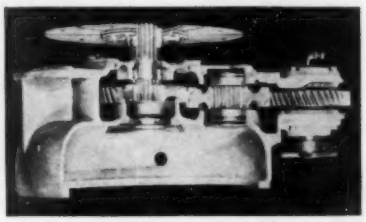
have straight bore bearings for shouldered shaft or alternatively adapter bearings for straight commercial shafting. Housing seats are machined to bearing widths plus ⅜ in., so that each block may be used as a floating unit or with a ⅜ in. stabilizing ring, as a fixed pillow block. Housing design with triple labyrinth seals, fits either oil or grease or adapts to circulating or oil-air mist systems. The spherical roller bearings used have land-riding machined bronze retainers with open end pockets allowing lubricant to reach all contact surfaces. Integral guide flanges prevent roller skew and strengthen the inner ring.

*Torrington Co., Bantam Bearings Div.*, South Bend, Ind.

**Circle No. 201 on Reader Service Card**

## Power takeoff unit

Called the P-200 Flywheel Power Takeoff, it bolts to the engine flywheel housing of any gasoline or diesel engine with either SAE No. 2 or SAE No. 3 bell housings. It adds



only 8 in. to the power train length. Two speed ratios—1.27:1 and 1:1—are available in standard production models. Power is transmitted from engine to vehicle clutch and transmission by a shaft running the length of the takeoff unit and through a helical type gear train to the PTO output shaft. Unit can deliver up to 70 hp without requiring changes in other power train components.

*Clark Equipment Co., Automotive Div.*, Jackson, Mich.

**Circle No. 202 on Reader Service Card**

## Torque control device

Device prevents driven member torques from overcoming driving member torques by use of a wedge action lock bar. This spring loaded bar remains wedged against an outer lock ring unless pressure is applied to the input shaft. Sleeve bearings used

*"Sure-Flex" Coupling's unique design, 4-way flex are . . .*

# A "SURE CURE" FOR SHOCK, VIBRATION, SHAFT MISALIGNMENT

Unique design and 4-way flexing action enable Wood's "Sure-Flex" Couplings not only to absorb all types and combinations of angular and parallel misalignment and end-float . . . but from 5 to 15 times more shock and vibration than other leading flexible couplings. There are only four basic parts which lock together without clamps or screws, tightening securely under torque to provide smooth, dependable power transmission. There is no metal-to-metal contact, no wear, no need for lubrication or maintenance. "Sure-Flex" Couplings are easily installed, unaffected by abrasives, dirt or moisture. Operation is noiseless. Get all of the facts. *Write for Bulletin 5103.*

Wood's

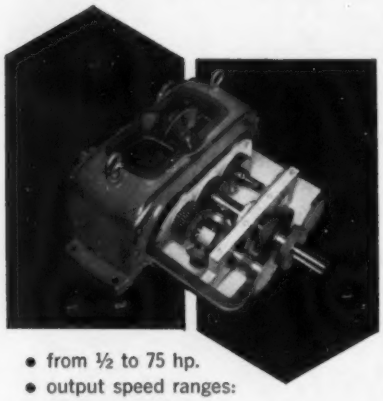
**T. B. WOOD'S SONS COMPANY • CHAMBERSBURG, PENNSYLVANIA**

SF/160A

ATLANTA • CAMBRIDGE • CHICAGO • CLEVELAND • DALLAS

**Circle No. 62 on Reader Service Card**

Specify
SPECON for
VARIABLE SPEED DRIVES
electrical and mechanical



- from ½ to 75 hp.
- output speed ranges: 0-100 to 0-7000 rpm
- smoothly adjustable through zero speed
- draw accuracies of .01%
- full torque at zero speed

These are just some of the outstanding characteristics of Specon variable speed drives. Rugged, reliable and requiring minimum maintenance, they permit infinitely fine adjustment of output speed with accuracies approaching fixed gearing. Specon drives also feature shockless starts and acceleration, full reversing, and provide output speeds up to 7000 rpm while maintaining zero speed features.

Send for FREE data booklet on Specon variable speed drives.

STRATOS
A DIVISION OF FAIRCHILD ENGINE & AIRPLANE CORPORATION
INDUSTRIAL PRODUCTS BRANCH
#42, Route 109, West Babylon, N. Y.

Circle No. 72 on Reader Service Card

**PRODUCTS** *continued*

are heat treated and precision ground. Load capacities from 50 to 26,000 lb-in. Lash on input and output shafts ranges from 2 to 4 degrees. Design can be modified to permit input and output shafts on the same side of the housing, dual output or input shafts and other variations. Pin-type or Woodruff Key connections as required.

*Ann Arbor Bearing and Mfg. Co.*, Ann Arbor, Mich.

**Circle No. 203 on Reader Service Card**

## Plastic miniature bearing packages

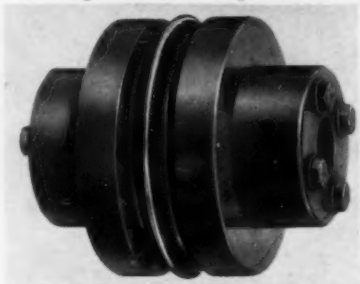
Bearings for military use are sealed in oil in plastic blisters of 15 mil Butyrate. This prolongs shelf life up to five years and prevents any form of contamination. For civilian customers, a similar system using polyester film protects bearings over a temperature range from —80 to 230 F and also greatly lengthens shelf life.

*Miniature Precision Bearings, Inc.*, Keene, New Hampshire.

**Circle No. 204 on Reader Service Card**

## Spacer couplings

Sure-Flex spacer couplings will connect shafts up to 7½ in. apart and may be removed without disturbing shaft alignment. A two piece rubber



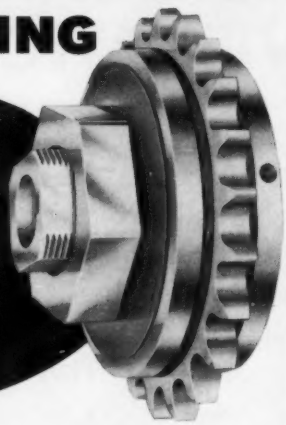
sleeve has teeth that lock into teeth in the flanges under torque. Shaft ends fit into the hubs which are attached to the flange by 4 cap screws and easily detachable, so that the central flange-and-rubber sleeve section can be lifted out. Angular misalignment tolerance up to 1 degree, parallel misalignment to 1/16 in., free end float up to ⅛ in. Spacer couplings are available on special order to fit particular requirements.

*T. B. Wood's Sons Co.*, Chambersburg, Pa.

**Circle No. 205 on Reader Service Card**

ELIMINATE BREAKDOWNS due to OVERLOADING

DALTON "OSD" OVERLOAD SAFETY DEVICE
PAT. APPLIED FOR



Ideal for use in conveyors, presses, farm machinery, construction equipment, material handling machines and applications of power transmission equipment.

- ALL STEEL CONSTRUCTION
- FEWER PARTS
- TORRINGTON NEEDLE BEARINGS LUBRICATED FOR LIFE

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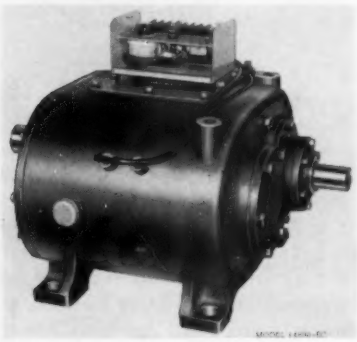
DALTON gear company
1750 HENNEPIN AVE., MINNEAPOLIS 3, MINN.

Manufacturers of
GEARS
SPROCKETS
COUPLINGS
ROLLER CHAIN

Circle No. 17 on Reader Service Card

## Magnetic clutch transmissions

Transmissions with electro-magnetic clutches provide speed changes and reversing under power without cutting off the power source. Available



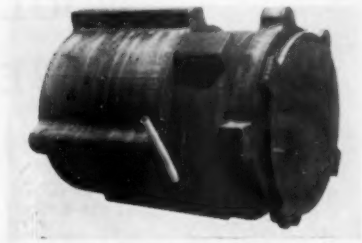
with two to eight speeds, capacities from 52 to 750 ft. lb. and wide ratio selection (up to 10:1). Manual or automatic control of speed changes with electric switches, tape, cam or other remote controls.

*Western Mfg. Co.*, Detroit 10, Mich.

**Circle No. 206 on Reader Service Card**

## Flame-cut gears

A natural-gas and oxygen process for cutting gears, sprockets, and pinions to customer specifications employs a "cool" flame that avoids hardening the surface and permits tolerances of $+\frac{1}{8}$ in., $-0$ in shapes cut from 6-in. plate. Custom gears made this



way are less expensive than castings and easier to machine. Thicknesses can be cut up to 28 in. Materials include low and high carbon steels, manganese and silicon steels, high carbon nickel, nickel chromium and molybdenum steels. Minimum practical thickness is $\frac{1}{4}$ in. for which tolerance is .030 in.

*Reliable Steel Plate Co.*, Cleveland, Ohio.

**Circle No. 207 on Reader Service Card**

## Torque converter transmission

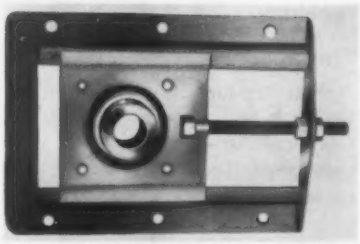
It's a 3-element, single stage converter transmission unit for direct connection to liquid or air cooled engines in the 18 to 35 hp range and features a gear type charging pump. Oil cooled disc shift clutches provide smooth shifting from forward to reverse, with a common lubricant serving both transmission and converter. Shaved steel gears for quiet operation. The extra-heavy shafts are mounted on ball and roller bearings.

*The Prime-Mover Co.*, Muscatine, Iowa.

**Circle No. 208 on Reader Service Card**

## Take-up bearing unit

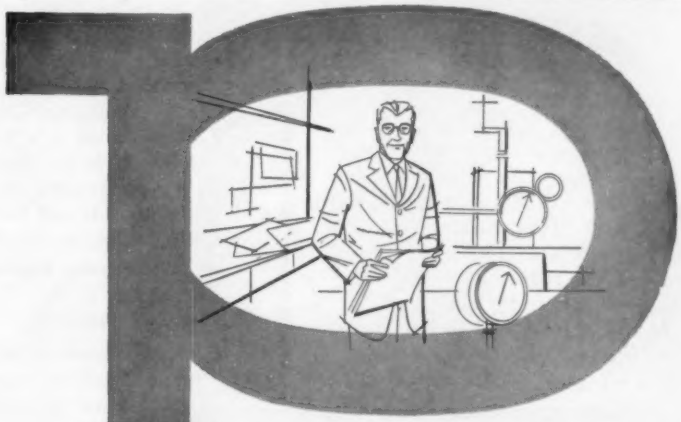
Available with or without frames,



unit uses inexpensive stamped bearings, prelubricated at assembly. Seals are of neoprene felt. Shaft sizes from $\frac{5}{8}$ through 1 in. For light duty applications.

*Roberts Mfg., Inc.*, Salina, Kansas.

**Circle No. 209 on Reader Service Card**

P LENTY OF
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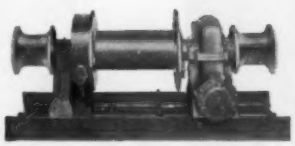


That's the guarantee you get when you put a Tulsa Winch to work . . . because Tulsa Winches are precision-made from highest quality materials, then tested to withstand pulls TWICE their rated capacities. They are designed for smoothest operation under the most rugged conditions . . . in a wide range of models and sizes. Also a complete line of power take-offs.

TULSA WINCHES

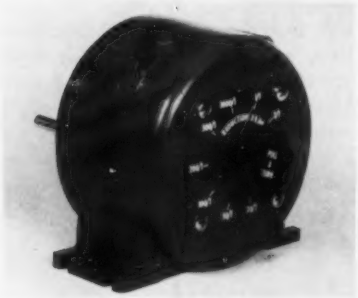
TULSA WINCH
DIVISION OF VICKERS INCORPORATED
TULSA, OKLAHOMA

**Circle No. 53 on Reader Service Card**

**PRODUCTS** *continued*

## Step-function reducer

A new version of the Insco Speed Reductor features a new chassis, oil-filled case, improved precision gears, redesigned bearings and a base mounting flange. Said to combine the



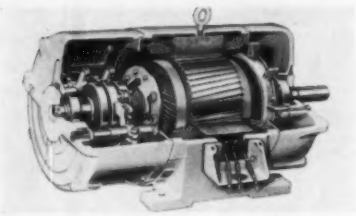
advantages of geared and friction type reducers, it comes in 5 models with 10 ratios of up to 1000:1 which can be selected without stopping the input shaft. Torque capacity to 50 oz. in., speeds to 1500 rpm continuous, 3000 rpm intermittent. Size 4½ in. diameter by 3 in. deep.

*Insco Co., Div. of Barry Controls, Inc.*, Groton, Mass.

**Circle No. 210 on Reader Service Card**

## Wound rotor motors

New line (NEMA frame sizes 213 to 326U) reduces both size and weight



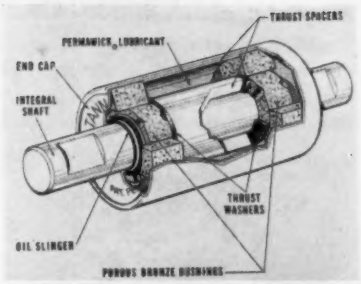
while retaining cast iron housing and end bracket construction with large size grease reservoirs. Rotor is precision wound and has both ends dynamically balanced. Rotor end coils are banded with an epoxy fiberglass to prevent end coil shorts due to wire cutting insulation. Other improvements include an advanced Class B insulation system resistant to moisture oil and abrasive dust. Open, drip-proof or totally enclosed for horizontal, ceiling or side-wall mounting.

*Louis Allis Co.*, Milwaukee, Wis.

**Circle No. 211 on Reader Service Card**

## Shaft bearing assembly

Recommended for applications where bearing noise or conducted resonance




are problems, assembly is designed to handle radial loads of 25 to 30 lbs at speeds of 400 to 5000 rpm at moderate thrust loads. A reservoir of Permawick self-wicking lubricant is constantly recirculated by oil slingers. Base life of at least 20,000 hours is predicted. Assembly has an outside diameter of 1.181 in. and a shaft diameter of .4995 in. in lengths up to 6 in. with other sizes planned for later production.

*Tann Bearing Co., Div. of Tann Corp.*, Detroit, Mich.

**Circle No. 212 on Reader Service Card**

## Frequency converter

A brushless frequency converter for single phase drive is designed to supply 3-phase, 400 cycle power from a 60-cycle source. Low slip, single


WHAT'S YOUR PROBLEM?

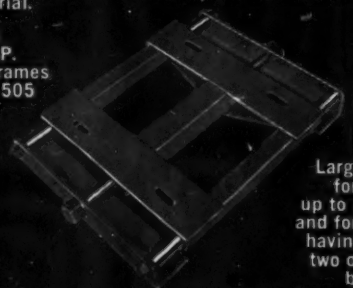
*Is it any of the following?*

- Diminishing output due to a progressive drop in rpm.
- Too much down-time because of the need for frequent adjustment due to belt stretch.
- Excessive maintenance time and expense.
- Poor belt and bearing life.
- A drive in an inaccessible or isolated location.
- A high-ratio short-center drive.

MOUNTING THE MOTOR ON AN "AUTOMATIC"® BASE MAY PROVE TO BE A SIMPLE AND ECONOMICAL SOLUTION

Motor mounting position and direction of pulley rotation are immaterial.

Stock Sizes
¼ to 125 HP.
for NEMA frames
56 through 505
and 445-U



Larger Sizes
for motors
up to 500 HP.
and for motors
having one or
two outboard
bearings.

AUTOMATIC MOTOR BASE CO.
WINDSOR, N. J.

**Circle No. 5 on Reader Service Card**



Free Sample Tube

Industry's NEWEST Production TOOL

MOLYKOTE® G LUBRICANT

- ALMOST 100% SAFETY AGAINST GALLING AND SEIZING WITH ALL BEARING METAL COMBINATIONS
- ELIMINATES STICK-SLIP, METAL PICK-UP AND DISTORTION IN PRESS FITTING
- REDUCES WEAR-IN TIME AND DAMAGE IN NEW OR REBUILT MACHINERY
- THE HIGHER THE LOADS, THE GREATER THE MARGIN OF SUPERIORITY OF MOLYKOTE G

Write for your free sample of MOLYKOTE G LUBRICANT today. We will also send you a copy of our new Bulletin 126 which gives complete details. THE ALPHA-MOLYKOTE CORPORATION, 65 Harvard Avenue, Stamford, Conn. Phone Fireside 8-3724. Plants in Stamford, Conn., Munich, Germany and Strasbourg, France.

PTD-10

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65 Harvard Ave., Stamford, Conn.
*Please send me a free sample of your MOLYKOTE G Lubricant.*

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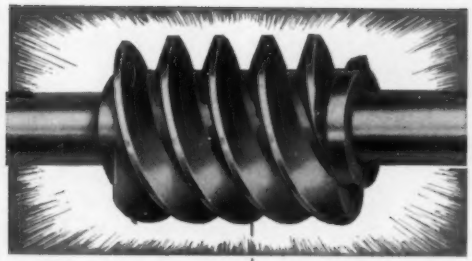
ADDRESS_____
CITY_____ ZONE____ STATE_____

**Circle No. 12 on Reader Service Card**



# Cleveland's Master worm principle enables exact mating of any replacement worm or gear...

*if ever required!*

These original Master Worms —our "common denominator" of quality—as well as all hobs for each size and ratio of Cleveland worm gearing are individually produced in our tool room to extremely close tolerances. Furthermore, each hob is painstakingly checked against the master worm—as are all Cleveland production worms and gears.

It's never necessary to replace Cleveland worms and gears in *sets*. Because, each Cleveland production worm or gear is a duplicate of each other.

A new gear will always mate exactly with an old worm and vice versa. Cleveland's Master Worms are never destroyed but kept in perpetual stock—always available at a moment's notice. So, you're guaranteed perfectly fitting worms or gears for service and maintenance requirements.

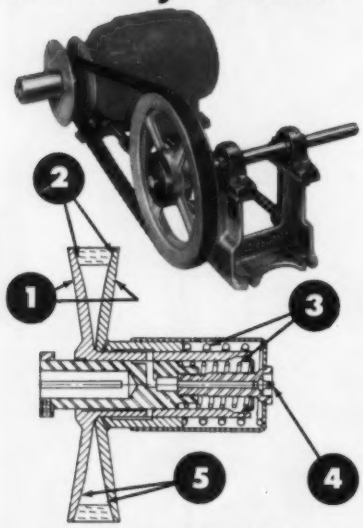
Get the complete story from your Cleveland Representative, today. Or, write us direct for free Bulletin No. 405—it gives full engineering information.

**Cleveland Worm & Gear Division**
Eaton Manufacturing Company
3273 East 80th Street • Cleveland 4, Ohio

**CLEVELAND**
Worm Gear
*Speed Reducers*

Circle No. 14 on Reader Service Card

# feature by feature...




## INDUSTRY'S MOST EFFICIENT VARIABLE SPEED PULLEY

1. Both sides of the driving disk open simultaneously and equally to give constant belt alignment.
2. Power is transmitted through sides of the belt to a grooved sheave to insure maximum efficiency and prevent slippage.
3. Each side of the driving disk is independently actuated by its own spring, eliminating ratchets, cogs, gears or other moving parts subject to constant maintenance and wear.
4. Oilite bronze bushings on fractional hp. units provide life-time lubrication.
5. Curved pulley faces maintain full contact with belt sides at all times, greatly increasing overall efficiency.

Pulleys are available in a complete range of sizes, fractional to 15 hp.—full 3 to 1 ratio. Immediate delivery from stock.

Request recommendations for your application. Ask for Catalog P-58.

Lovejoy FIRST NAME IN VARIABLE SPEED PULLEYS

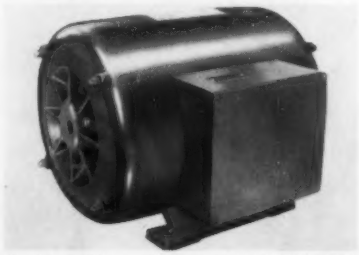
LOVEJOY FLEXIBLE COUPLING CO.

4852 West Lake Street, Chicago 44, Illinois
Telephone: ESTebrook 9-3010

Circle No. 32 on Reader Service Card




phase motor is integral in a cast aluminum shell with a NoBrush 400 cycle alternator. No external regulator is needed. Output is 3-phase,



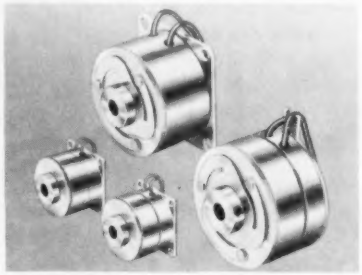
4-wire, 120 to 208 v., 2.5 KVA. Dimensions including terminal box are: width 13⅞ in., length 15¾ in., height 11 9/16 in. Weight is 147 lb. Other ratings in this model, single or 3-phase drive, from 125 VA to 3 KVA.

*Georator Corp.*, Manassas, Va.

**Circle No. 213 on Reader Service Card**

## Electric brakes/clutches

A new line of fractional hp clutches and brakes is being produced in two sizes: .875 in. diameter with 2 lb.-in. torque, and 1.725 in. diameter with 10 lb.-in. torque. Power is 28 or 90



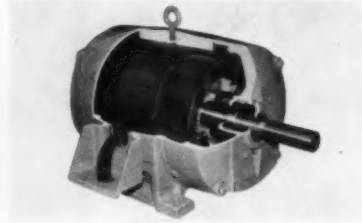
volts standard. Control units are available. Additional sizes are under development.

*Haydon Div. of General Time Corp.*, Torrington, Conn.

**Circle No. 214 on Reader Service Card**

## Squirrel-cage motors

Design feature of these motors is an epoxy winding encapsulation which is applied under vacuum to surround each wire in slots and at coil ends to produce a solid homogeneous mass. The new line is said to provide open motor performance in applications usually needing enclosed motors. Motors come in NEMA designs A, B, C and D, 3 or 2-phase, 1 through 125 hp ac for 1, 2, 3 or 4-speed constant or variable torque operation. All standard voltages and frequencies.

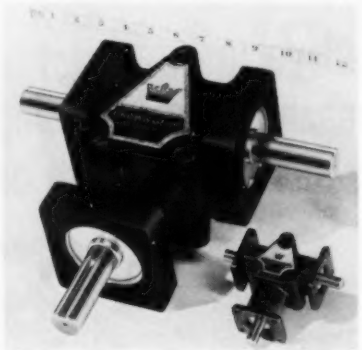


*Howell Electric Motors Co.*, Howell, Mich.

**Circle No. 215 on Reader Service Card**

## Right-angle drive

For heavy-duty applications, this package drive delivers 8 hp at 1100 rpm. Design data gives weight 18 lbs, shaft diameter 1 in., shaft extensions



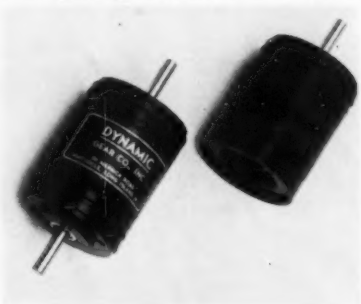
2¾ in. Housing dimensions are 6½ in. x 8¼ in. x 4 in. Other design points include 8620 hardened spiral bevel gears, double sealed ball bearings and stainless steel shafts.

*Crown Gear Div., Harrington & Richardson, Inc.*, Worcester, Mass.

**Circle No. 216 on Reader Service Card**

## Postless reducers and gearheads

Whole number ratios, accurate to within .5%, are the feature of a line of Buord Size 11 reducers and gearheads. They come in over 190 stock ratios from 7:1 to 5950:1 with a fractional ratio of 5¼:1 also available. Units measure 1.420 in. overall with an output torque of 75 oz. in., starting torque .005 oz. in. and back-



FALK and STEELFLEX are Registered Trademarks

## Cut disconnect-reconnect time by as much as 50%

The FALK Spacer Coupling is specially designed for quick installation or removal *without disturbing the driving or driven unit.* This feature can save you up to 50% in disconnect-reconnect time when critical equipment—a process pump, for example—needs repair or replacement.

Here's another saving: with the FALK Spacer Coupling, you can quickly realign shafts *without the usual loss of operating temperature!*

And still another: you can remove or reinstall the FALK Spacer as a unit *without draining the lubricant.*

Because of its exclusive grid-groove Steelflex design, the FALK Spacer can accommodate residual misalignment—parallel, angular, or (most important) *both.* Also, it provides torsional resiliency that cushions shock and vibration. Thus it saves wear-and-tear on your connected equipment.

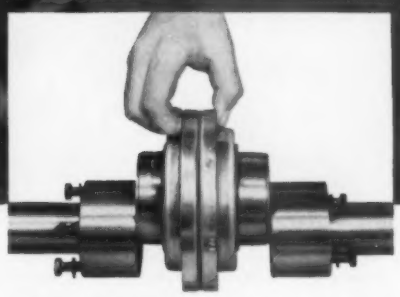
To prove these claims and enjoy these savings, install a FALK Spacer on one application—and see for yourself. Consult your FALK Representative or Authorized Distributor.

**THE FALK CORPORATION, MILWAUKEE 1, WISCONSIN**

*MANUFACTURERS OF QUALITY GEAR DRIVES AND FLEXIBLE SHAFT COUPLINGS*

**Representatives and Distributors in many principal cities.**

**Circle No. 24 on Reader Service Card**

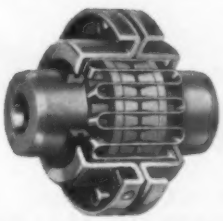


### EASY AND QUICK TO INSTALL, DISCONNECT OR RECONNECT

First, mount shaft hubs to allow proper distance between hubs; then, align driving and driven units.

Second, compress Spacer to fit space between hubs and tighten cap screws to pull spacer hubs into the registered fit.

To disconnect, reverse the second step. No draining of lubricant necessary.



**The heart of the FALK Spacer ...the basic Type F Steelflex**

*Write for Service Manual 4838*

**FALK**

...a good name in industry

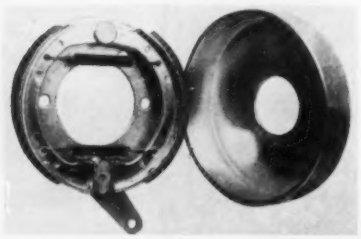
lash 30 minutes max. Input, output and pinion shafts are all heat-treated #416 stainless. Gears are #303 stainless. Bearings, shielded throughout, are ABEC-7, with bronze bearings available.

*Dynamic Gear Co., Inc.*, Amityville, N. Y.

**Circle No. 217 on Reader Service Card**

## Internal expanding brakes

A lever-actuated cam forces the lined shoes apart against the inside of the revolving drum. Springs return the shoes to their former position when the lever is released. The drum may be welded or fastened with cap screws to sprocket, wheel hub or adapter flange. The stationary brake mechanism fastens to the axle.



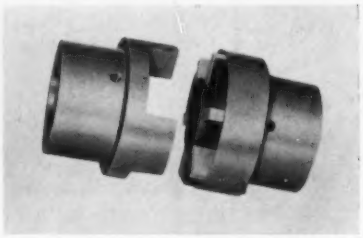
Mounting plate bolt circles are 3 in. diameter, positioned to take flange type bearings if needed. Comes in a variety of bores and widths, with an adapter for mounting on axles with set screws and keyways.

*Fairbanks, Morse & Co., Magneto and Engine Accessories Div.*, Beloit, Wis.

**Circle No. 218 on Reader Service Card**

## Flexible Coupling

Model GH heavy duty coupling is produced in sizes from 35 to 700 hp at 1800 rpm for shafts up to 5½ in. diameter. Interlocking jaws are separated by a load cushion to avoid metal contact and reduce vibration, shock loads, and misalignment. Removable individual inserts, held in place by a steel collar, can be replaced without disturbing driving or driven units. Inserts available for all operating conditions and government specifications.



*Gerbing Mfg. Corp.*, Elgin, Ill.

**Circle No. 219 on Reader Service Card**

## Miniature components

Available in Precision 1, 2, and 3 tolerances and conforming to military specifications, this redesigned line comes in 5/64 in., 3/32 and ⅛ in. shaft sizes and includes gears,

shafts, differentials, ball bearings, collars, spacers, gear plates and other components for prototype or production use.

*PIC Design Corp.*, East Rockaway, N. Y.

**Circle No. 220 on Reader Service Card**


# "CHAIN LUBE"

**GOES ON LIKE OIL—STAYS LIKE GREASE**

LUBRICATES
- ROLLERS
- BUSHINGS
- BEARINGS

INSIDE & OUT

**WILL NOT:**
- DRIP
- FLY OFF
- DRY OUT

**IT'S WATERPROOF. THE PERFECT LUBRICANT FOR ALL CHAIN SIZES. ASSURES LONG, TROUBLE-FREE PERFORMANCE—LOWER MAINTENANCE COSTS. COMBATS RUST AND MOISTURE.**

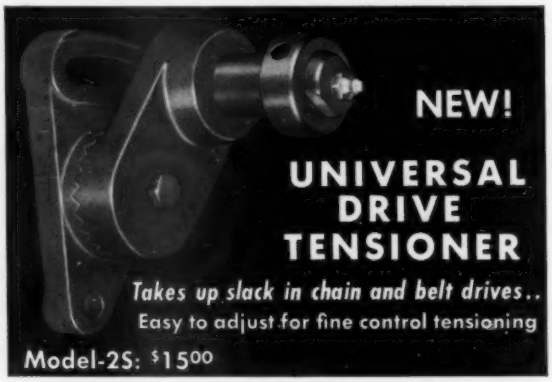
## THE McGLAUGHLIN OIL CO.

**3750 E. Livingston Ave. Columbus 13, Ohio**

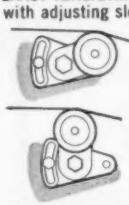
***FREE SAMPLE CAN SENT WHEN REQUESTED ON COMPANY STATIONARY***

**Circle No. 33 on Reader Service Card**






EXACT TENSIONING with adjusting slot



Rotating arm permits controlled tensioning at any point on a 360 degree arc, without changing base.

Reduce horsepower losses through belt slippage, eliminate shock loading on chain drives, increase the life of your equipment with the Universal Drive Tensioner. Two bolt mounting makes it more adaptable to machine frames. For single drives 2" long shaft furnished . . . also available are 3" and 4" long shafts for multiple width drives. This unit is also ideal as idler bracket in gear train. Contact your distributor or write . . . Patent Pending

## BREWER MACHINE & GEAR CO.

**1441-43 N. 2nd St., St. Louis 6, Mo.**

**Circle No. 9 on Reader Service Card**

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THE ASSOCIATION OF BEARING SPECIALISTS is an organization of carefully qualified, expertly staffed, thoroughly reliable firms . . . dedicated to the important task of supplying America's finest brands of bearings and power transmission equipment to industry!

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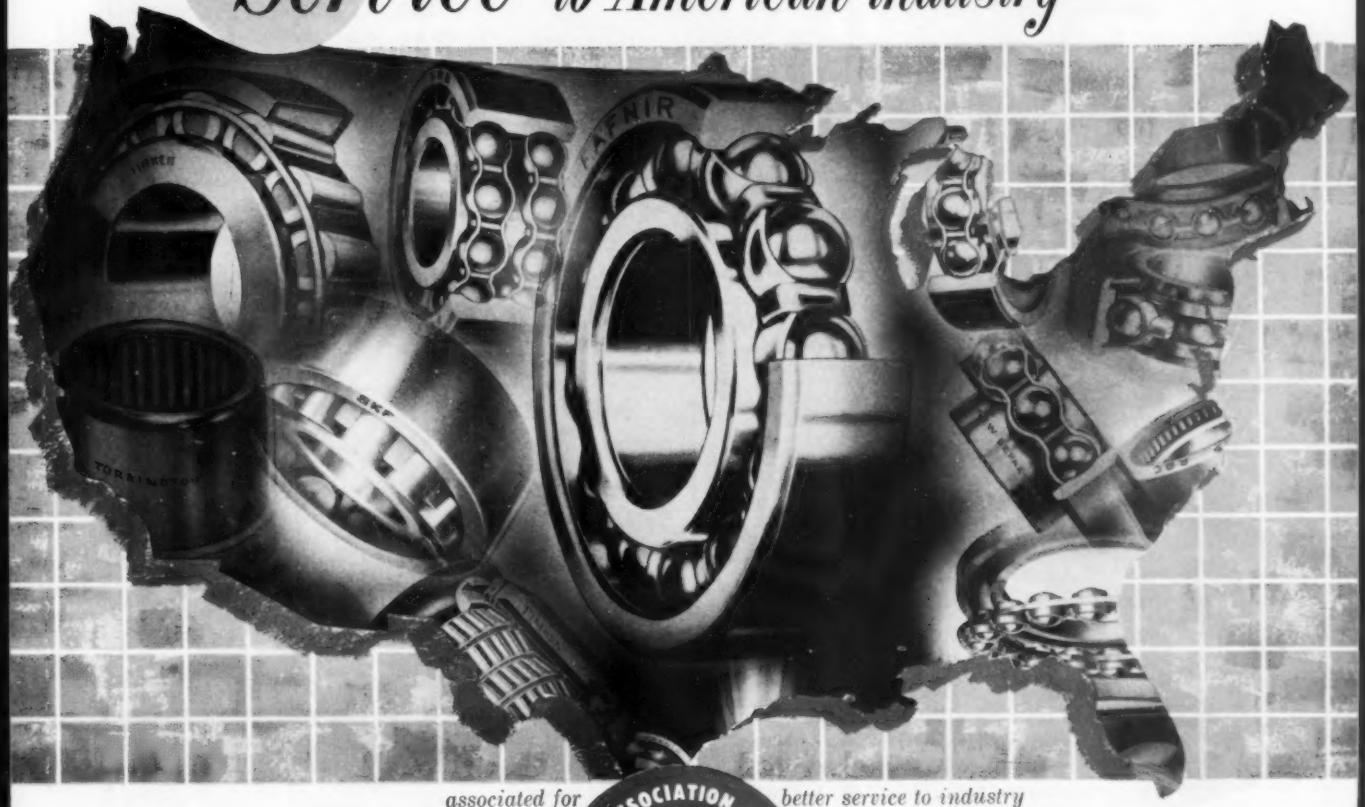
- *If you require the counsel and advice of experts in bearings and power transmission equipment..*
- *If you want to be assured of the right part . . . at the right time from readily available inventories . . .*

make it a point to contact your nearest member of ABS.

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**Davenport, Iowa**
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**Denver, Colorado**
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**Des Moines, Iowa**
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**Duluth, Minnesota**
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**Detroit, Michigan**
Michigan Bearing
**El Dorado, Arkansas**
Coastal Plains Supply
**Eureka, California**
Bearings & Trans. Prod.
**Fairbanks, Alaska**
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**Grand Rapids, Michigan**
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**Hibbing, Minnesota**
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**Highland Park, New Jersey**
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**Houston, Texas**
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**Indianapolis, Indiana**
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Bearing Industries
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Precision Bearing & Trans.
**Orlando, Florida**
Miller Bearings
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**Seattle, Washington**
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**Shreveport, Louisiana**
Bearing & Trans. Co.
**Sioux Falls, South Dakota**
Western Bearing
**Spartanburg, South Carolina**
White Bearing
**Spokane, Washington**
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Binkelman Bearings
**Trenton, New Jersey**
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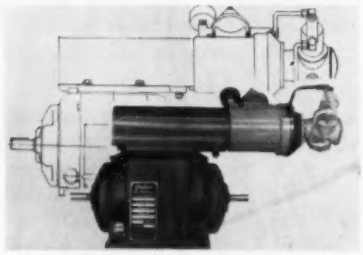
Bobker Bearings
**Wichita, Kansas**
B-R-C Bearing
**Wilkes-Barre, Pennsylvania**
Keystone, Bearing

**Circle No. 6 on Reader Service Card**

## Air controlled variable transmission

An air control provides remote or automatic speed control over an infinite range. Speed may be set by manual air valve or by a signal generated by a variety of pneumatic transducers. Control is worked by a



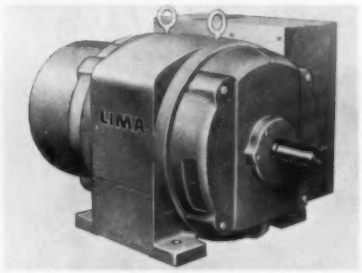
pinion driven by a rack mounted on the piston of the pneumatic actuator. Pinion shaft carries a steel cam cut so that equal changes in the air pressure signal will produce equal changes in speed. Movement of this cam causes axial movement of a control ring which engages three tapered rollers supported in a carrier joined to the motor shaft. Pinions fixed to the large end of the rollers engage a ring gear on the output shaft. Contact pressures between the rollers and traction ring develop centrifugally, allowing speed changes with the transmission running or stationary. Available with several styles of built-in reducers and a variety of motors. Also with micrometer, remote micrometer, and electrical controls.

*Graham Transmissions, Inc.*, Menominee Falls, Wis.

**Circle No. 221 on Reader Service Card**

## AC generators and motor generators

A new line comes in ratings from 5 KW through 100 KW in open type construction with stator-excitor regulators. Inherent regulation to ±10%,




or magnetic amplifier regulation to ±1%. Another line of brushless ac generators in dripproof construction are rated at 5 KW at 1800 rpm through 100 KW at 1800 rpm, with inherent regulation. Totally enclosed fan-cooled types are rated at 5 KW at 1800 rpm through 50 KW at 1800 rpm. These brushless generators can handle high intermittent low power factor loads with minimum voltage dip.

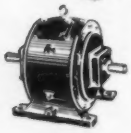
*Lima Electric Motor Co. Inc.*, Lima, Ohio.

**Circle No. 222 on Reader Service Card**

## Retaining ring pliers

The Truarc No. 12 pliers can be used in two ways—to compress internal type rings for insertion into a bore or housing or to expand external type rings for fitting around a shaft. An adjustment of the pivot pin on which the two halves of the

Abart SPEED REDUCERS for
• ECONOMY •
• ACCURACY •
• LONG SERVICE-LIFE •



Horizontal or vertical drives; inputs from either side; right, left, top or bottom outputs. A size and type for every application. Ratings from 1/20 to 400 h.p. Ratios up to 10,000 to 1.

Compact precision-built Abart Speed Reducers make the most of your power. Simplified trouble-free design and construction assure lower operating and maintenance costs.

Write today for Abart's fact-packed pocket size speed reducer catalog. See the results of 30 years of careful specialized study on thousands of speed reduction problems.

ABART GEAR and MACHINE CO.
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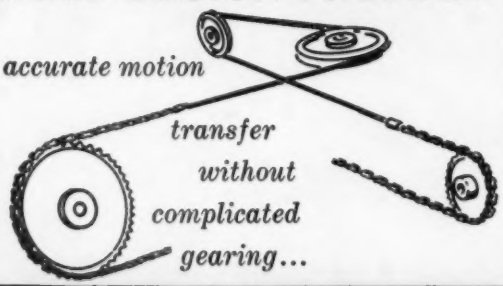
**Circle No. 7 on Reader Service Card**

MORE DESIGN FREEDOM

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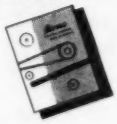
Provide precise, positive motion transfer through several planes simultaneously with no cable slippage...no complicated gearing. Unlimited center-to-center selection for miniature and sub-miniature assemblies in servo systems, gyro systems, special cameras, electronic equipment, and small precision instruments. Less weight, cost, maintenance —wider tolerances. Designed to operate around minimum 7-tooth sprocket with root diameter of .250 inches. Chain pitch .1475 inches; Weight .45 oz. per lineal ft. Material: stainless steel, or other materials.

NEW CATALOG



Contains useful application data, specifications, tables on chain pitch and sprocket sizes, suggestions for calculating center-to-center distance. *Write for yours today.*

123 E. Montecito Avenue, Sierra Madre, California

Sierra ENGINEERING CO.

T. M. REG.

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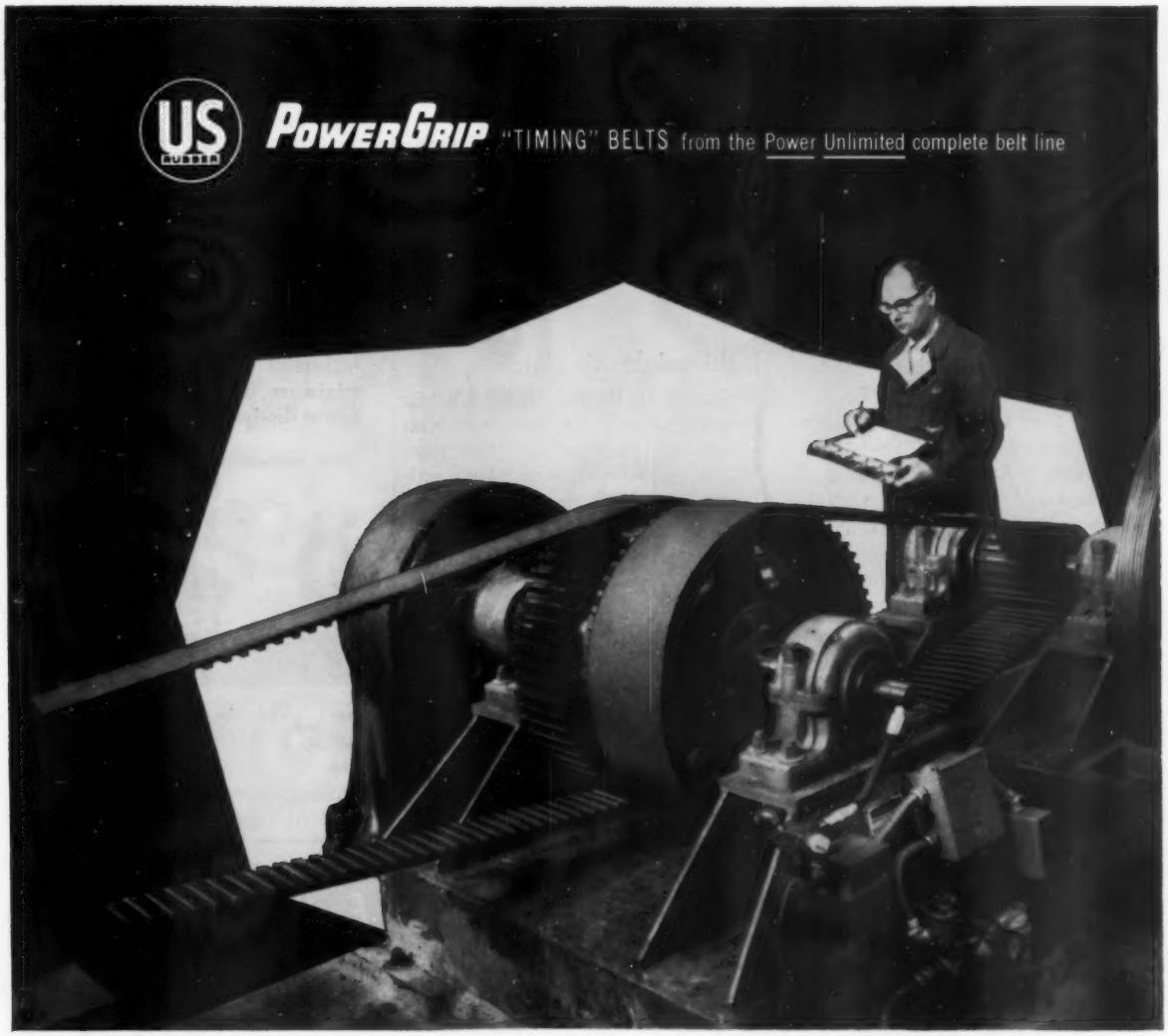
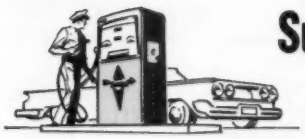


# Sun Oil Company obtains positive results with U.S. PowerGrip "Timing" Belts

The octane requirements for cars are determined by the Sun Oil Company with scientific accuracy. The octane ratings of motor fuels are in turn determined with precision. Nothing is left to chance. This is why the motorist can pull up at a Sunoco station and obtain the correct octane blend for his car.

All of this predetermination is done on precision equipment whose universal joint drive shaft is connected to a dynamometer by a 1¼" pitch U. S. Rubber PowerGrip "Timing"® Belt. In the words of a company scientist, these belts were selected because they give foolproof, positive drive transmission and do not require lubrication, maintenance or attention. Anything less would interfere with the precision of the testing equipment. This is the experience that has caused innumerable design engineers to specify PowerGrip.

This is the belt that has made possible the development and production of hundreds of appliances and equipment, ranging from sensitive electronic devices, office machinery, household equipment and gigantic production machinery. One way to get expert and instant power and transmission advice is from the U.S Distributor.

US RUBBER

Mechanical Goods Division

**United States Rubber**

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

**Circle No. 55 on Reader Service Card**

pliers turn sets the tool so that the tips come together or spread apart when the handles are pressed. The pliers can be used for shafts and housings from .125 to 1.375 in. diameter, depending on ring type. A larger size, the No. 34, will handle sizes from .434 to 2.0 in.

*Truarc Retaining Rings Div., Waldes Kohinoor, Inc.*, Long Island City, N. Y.

**Circle No. 223 on Reader Service Card**

## Low carbon bearing balls

Intended for lower cost precision bearing assemblies, these balls are made from S.A.E. 1010-1020 steel carburized and tempered to a minimum surface hardness of R.C. 60. Balls are held to AFBMA Grade 50 and Grade 25, for which diameter tolerances are .000050 in. and .000025 in. Range of sizes initially offered is from 1/16 through 3/8 in.

*Pioneer Steel Ball Co., Inc.*, Unionville, Conn.

**Circle No. 228 on Reader Service Card**

## Synthetic instrument grease

A lithium soap grease called Anderol L-793 is for instrument type applications over a temperature range of —75 F to 300 F. Base fluid is a medium viscosity diester oil that leaves no deposits on precision parts and protects them against rust. Available in 1 and 5 lb cans, 14 oz. cartridges, and 35, 100 and 400 lb drums.

*Lehigh Chemical Co., Industrial Lubricant Div.*, Chestertown, Md.

**Circle No. 229 on Reader Service Card**

## Light-weight air clutch

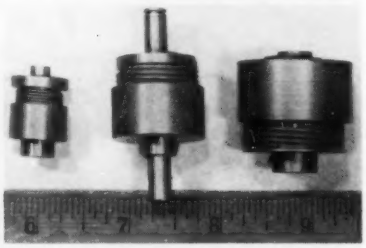
Weighing 15 lb, the Model LW air operated clutch is for use with motors up to 5 hp at 1800 rpm. Clutch is self-adjusting, has anti-friction bearings, requires no rotary joint, and is a combination motor sheave and clutch. Sheave is designed to fit the new 3V belts for a compact drive arrangement which gives shockless starts without overheating.

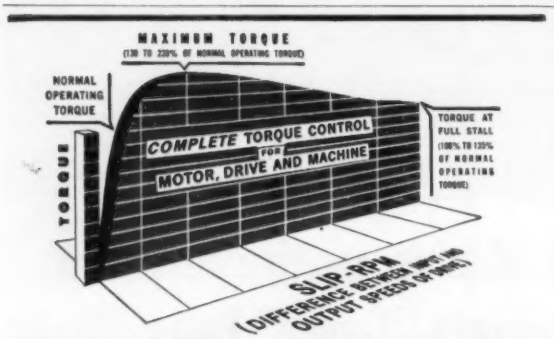
*Horton Mfg. Co., Inc.*, Minneapolis, Minn.

**Circle No. 224 on Reader Service Card**

## Spring wrapped slip clutches/brakes

A line of slip clutches and brakes has 48 in. oz. slip elements designed to withstand continuous slip for a minimum of 500 hours at a rated power dissipation of 4 watts. The element producing slip is a stepped spring. Inside diameter of the small step fits tightly over the input drum. Outside diameter of large step is assembled tightly in the bore of the




**Add this *Safe* controlling device to *your* equipment with GLEASON-TORMAG® Magnetic DRIVES**

It's the best way to prevent motor burnouts, broken machine parts, product spoilage, production downtime . . . GLEASON-TORMAG Drives with permanent magnets give you a "cushion" on every installation that will minimize overload shocks, reduce heavy starting loads, prevent damage from jams and stalls, and permit motor operation without over-heating and damage. No fluids, particles, seals, brushes, or exciters to require maintenance.

Add this protection *now* — write on your company letterhead for new catalog TP260 and engineering suggestions.

**TORMAG PRODUCTS** *Division, Gleason Reel Corp.*
738 N. Plankinton Ave., Milwaukee 3, Wis.
Representatives in Principal Cities in U.S. and Canada

**Circle No. 52 on Reader Service Card**

**Protects bearings by automatically maintaining a constant oil level.**

**Compare these BETTER DESIGN FEATURES!**

- New top filler cap — no need to remove reservoir
- Rugged reservoir construction — reduces breakage
- Remote mounting if desired
- Extra-high surge level
- Dustproof construction

Only Oil-Rite Constant Level Oilers bring you all these greatly improved features.

There are many applications where they can be used advantageously to maintain oil at a constant level. Ring oiled and anti-friction bearings, gear boxes, pillow blocks, pump housings, etc. are only a few ideal installations.

Let us show you how these and other new Oil-Rite developments can save you costly maintenance and down time through better lubrication.

**Complete application engineering service available. Send for FREE catalog today.**

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DISPENSERS • OIL GAUGES
CHAIN OILERS • OIL CUPS

**Oil-Rite**
**CORPORATION**
2329 Waldo Boulevard, Manitowoc, Wis.

**Circle No. 39 on Reader Service Card**

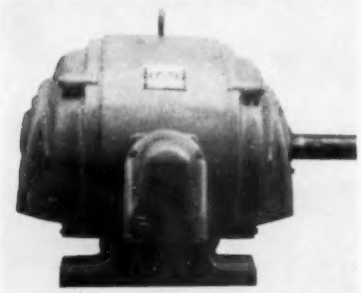
output drum. Rotation of the shaft in one direction causes the coils in contact with the input to grip tightly and the coils inside the output bore to contract and produce slip. Rotation in the opposite direction reverses the action of the spring parts and the input drum slips. The clutch can thus give the same or different torque capacities for the two directions of rotation. Torque levels where slippage occurs are independent of each other. Standard units have ratios of up to 10:1, with ratios of 100:1 available in special designs.

*Machine Components Corp.*, Jericho, N. Y.

**Circle No. 225 on Reader Service Card**

## Modified ac motor

The 364U ac drip-proof motor, with ratings from 20 to 40 hp, comes in a



modified version that has a splash resistant enclosure, a bearing cap, labyrinth seal on the output shaft, double shielded ball bearings and high dielectric insulation windings.

*Sterling Electric Motors, Inc.*, Los Angeles, Calif.

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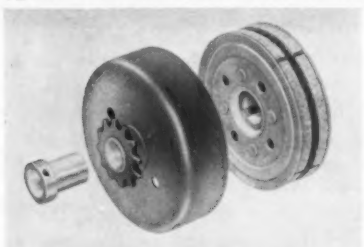
## Sprocket clutch

Clutch action of a sprocket-type clutch is locked if required by two ¼ in. bolts. Clutch has a case hard-



ened sprocket and full sleeve supported bearing. Models from 9 to 14 teeth, fitting ½, ⅝, ¾, ⅞ in. shafts.

*Automatic Steel Products, Mercury Clutch Div.*, Canton, Ohio.

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Designers and builders have found MAXITORQ Overload Release Clutches the ideal way to provide dependable protection against overload conditions.

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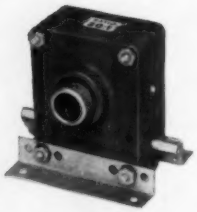

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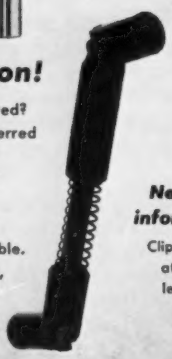

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**F-106 GENERATOR DRIVE** *continued from page 26*

Total weight of the gearbox unit is 110 lb. This does not include the four generators which mount on it, of course.

**Governor system:** Output frequency is sensed and compared with a standard frequency source. Current from a frequency comparator circuit creates a magnetic field which acts on two governor valves. One governor valve gives proportional control of the pump swash plate angle to maintain constant output speed. The other governor is a limit device which functions if the other malfunctions to put the pump swash plate at its minimum angle, and operates a pressure switch to take the generators off the lines. The same pressure switch works in conjunction with the proportional governor to keep the generators disconnected if an underspeed condition exists.

## Lubrication

Four pumps in addition to the one in the engine-driven gearbox are used for operation, lubrication, and cooling of the drive. The generators are also oil cooled.

MIL-L-7808 synthetic oil is used for lubrication and hydraulic fluid. Total flow rate is 10.5 gpm. Engine air bleed into the main gear box maintains 5.0 psia minimum at pump inlets to prevent cavitation at high altitudes. A cooler keeps oil temperature below 275 F.

Rotation of the engine starts the scavenge pump in the engine-mounted gear box. Pressure from this pump opens an anti-drain valve in the inlet to the main gear box. Oil from the reservoir can then flow to the start and cooling pump inlets. Oil from the start pump charges the cylinder blocks to start the transmission rotating.

Rotation of the transmission output shaft then drives cooling pump, charge pump, and the main gear box scavenge pump. The cooling pump supplies oil to cool the generators and engine-mounted gear box, and to lubricate the engine-mounted gear box. All return oil is to the sump of the main gear box. Drive end bearings of the generators are lubricated by oil mist in the main gear box.

Magnetic chip detector drain plugs are used in each gear box. An 80 micron filter protects the hydraulic pump and motor.

## Installation

The main gear box with generators installed is shaped to fit around the lower surface of the engine. The whole assembly may be swung down out of the aircraft for servicing or replacement of gear box or generators, Fig. 7. It swings on the outboard mounting bracket.

To lower the box, the access door is opened, the drive shaft disconnected, hydraulic and air lines disconnected, and two inboard mounting bolts removed. The gear box may then be lowered by cable from a crank hoist bolted to a fuselage structural beam. Installation is just the opposite. A safety latch on the inboard mount keeps this all from happening accidentally. ▲▲▲

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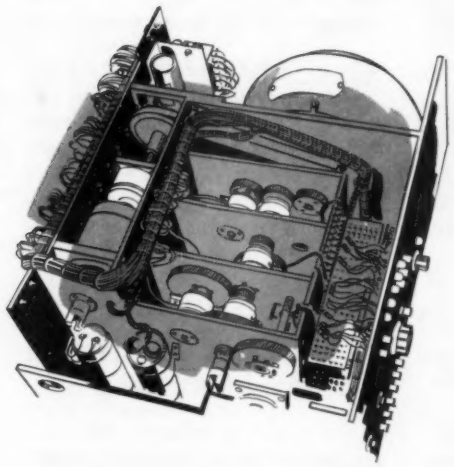

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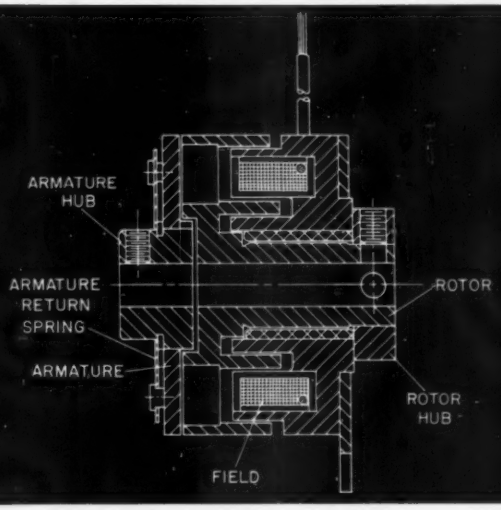


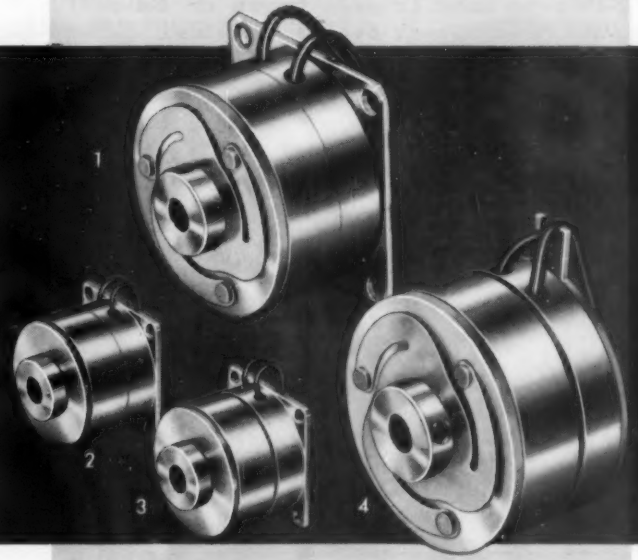


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# LITERATURE *on drives and components*

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***V-BELT DRIVE*** . . . Super Wedge Drives are said to reduce drive size up to 50% and drive costs up to 20% with no loss in hp. Catalog SW-1 tells how. Also includes selection tables, hp ratings, sheave dimension tables, and installation instructions covering belts, sheaves and bushings. *Maurey Mfg. Corp.*, Chicago, Ill.

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***CONTROLLED-TORQUE PULLEYS*** . . . Data sheet gives the mechanics and specifications of two models in the Torque-Master "Red Cap" series. Model #54 is rated at up to 50 in. lb. for ½ hp at 1750 rpm; model #64 up to 100 in. lb. for ¾ hp at 1750 rpm. A second sheet tabulates performance details of the XB-150 torque limiter. *Torque-Master Div., Roberts Aircraft Engine Co.*, Burbank, Calif.

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***TORQUE CONVERTORS*** . . . single stage types and convertor-transmission packages are described and specified in Bulletin No. 511. Package units provide automatic torque multiplications in all gear ratios so that sudden load increases can be handled without shifting gears. Capacity range is to 300 hp and up to 650 lb-ft of torque. *Twin Disc Clutch Co.*, Racine, Wis.

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***FORM WOUND MOTORS*** . . . of 150 hp and up have windings applied in successive layers of silicone rubber over pre-dipped coils to form a uniform sheath that's then welded into a homogeneous material resistant to chemicals, heat, oils, detergents etc. Bulletin F-2022 gives all the details. *U. S. Electrical Motors, Inc.*, Los Angeles, Calif.

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***TIMING DRIVE BULLETIN*** . . . gives a method, with the minimum of mathematics, of selecting a drive to fit any application. Five sets of curves for drive-width selection simplify calculations. A standard timing belt catalog is the only other outside reference needed. Method is illustrated by a sample problem. *T. B. Wood's Sons Co.*, Chambersburg, Pa.

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***INSTRUMENT SPUR GEARS*** . . . technical booklet #5 in this series outlines specifications on low inertia, custom made, certified military type fine pitch spur gears. Also detailed is a standard stock specification numbering system which covers all basic variables (number of teeth, pressure angle, diametral pitch etc.) and is said to save time and costs by use of standard stock gear blanks. *PIC Design Corp.*, East Rockaway, N. Y.

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***HIGH TEMPERATURE MOTOR*** . . . has a working ambient temperature range of —65 F to 600 F. Four page Product Bulletin PS-8A contains performance curves, outline drawing, engineering data and a section on special design features. *Airborne Accessories Corp.*, Hillside, N. J.

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***SPEED VARIATOR*** . . . for motors from ¾ to 10 hp uses Thyratron tubes to convert ac to dc power. Rectifiers vary armature and/or field voltage to give a wide stepless range of motor speeds. Bulletin GEA-7019 has 8 pages of illustrated information on applications, standard features and modifications for user's specific needs. *General Electric Co.*, Schenectady, N. Y.

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***RARE EARTH METALS*** . . . 24-page booklet describes and defines the properties of sixteen high purity metals such as vanadium, titanium, niobium etc. Illustrates machines and research equipment and includes property-analysis charts. *Lunex Co.*, Pleasant Valley, Iowa.

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***ELECTRIC EQUIPMENT CATALOG*** . . . has 300 pages divided into 25 sections covering heavy duty equipment specifications and prices. Includes an easy estimator in each section for pricing. Gives data on motor ratings and generally accepted industrial control definitions. *Continental Electric Co.*, Cincinnati, Ohio.

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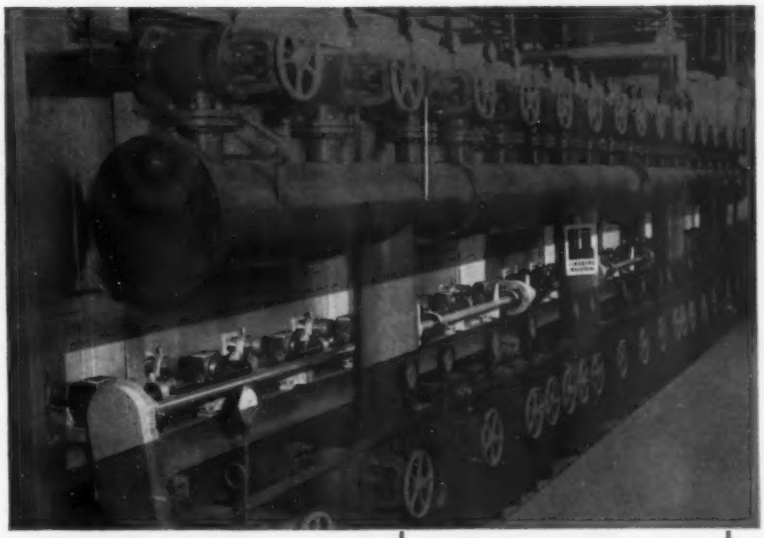

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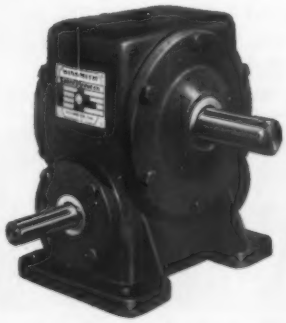

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**LITERATURE** *continued*

***AC MOTORS*** . . . designed to meet government specifications for aircraft and missile electro-mechanical linear and rotary actuators, servos, pumps and valves. Data sheet 107-2 gives the details on hp, torque, speed, duty cycle, weight and size. *Lear, Inc.*, Grand Rapids, Mich.

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***BEARING DATA SHEETS*** . . . contain complete dimensional specifications and load factors for Series R2, R3 and R4 instrument bearings made to ABEC class 7 tolerances. *Miniature Precision Bearings, Inc.*, Keene, N. H.

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***MOTOR SELECTION GUIDE*** . . . GED-3909A is a 3 by 7 in. card for quick reference to frame size (182 to 445U) and book price for ac motors from ¾ to 125 hp. Tabulated data for both dripproof and totally enclosed, fan-cooled squirrel cage, horizontal motors. Motors are 3-phase, 60 cycle for 208-220/440 or 550 volts. *General Electric Co.*, Schenectady, N. Y.

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***STEEL, CAST IRON COLLARS*** . . . specifications for all sizes up to 4-15/16 in. bore diameter and two new miniature sizes for shafting 1/16 and 1/32 in. diameter are included in Bulletin No. 2638. Explains and illustrates action of self-locking socket set screw fitted to all steel collars and smaller sizes of split cast iron types. Also describes optional Nylok self-locking screw feature for plain cup or flat point set screws. *Industrial Fastener Div., Standard Pressed Steel Co.*, Jenkintown, Pa.

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***BEARING UNIT CATALOG*** . . . No. 60 illustrates and specifies bearing cartridges, pillow blocks, (including jack-shaft types) and self-aligning take-up units, among other products. Tabulates dimensions and load ratings, rounds out data with line diagrams. *Roberts Mfg. Co.*, Salina, Kansas.

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***LEVELING MOUNTS*** . . . and vibration isolators are the subjects of Bulletin 60-04 (mounts) and Bulletin 59-04-12 (isolators). Construction, dimensions and methods of application of series LM mounts and series 6300 and 6550 isolators are illustrated and described. *Barry Controls, Inc.*, Watertown, Mass.

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***BEARING CATALOG*** . . . No. 101 contains 16 pages of descriptive data on 15 bearing types, ranging from standard stud, bore and flange bearings to garage door rollers, nylon rimmed bearings and the Rollset line. *General Bearing Co., Inc.*, Mineola, N. Y.

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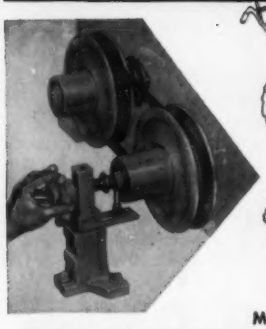

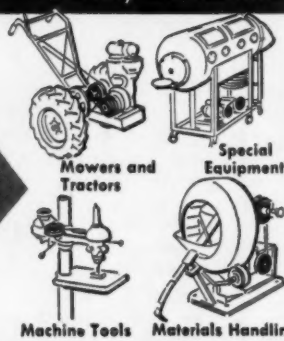


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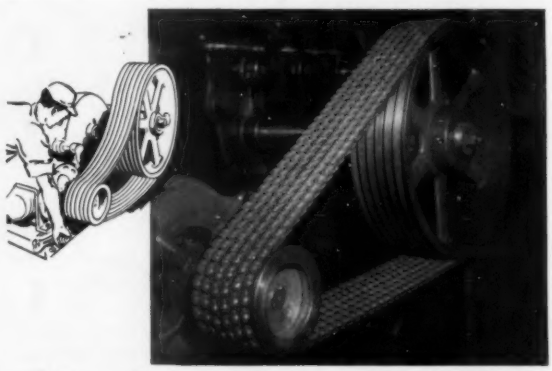

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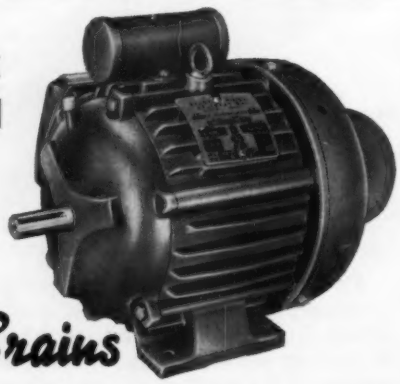
this new Brook totally enclosed fan cooled, single phase motor has



*Brawn and Brains*

The BRAWN is in the rugged design, producing cool operation and long service life and in the housing, which keeps out dust and moisture . . . and the external fan which blasts cooling air over the heat dissipating fins on the housing.

The BRAIN is in the external centrifugal switch which positively disengages when motor has attained pre-set speed. Switch is on outside of motor for accessibility . . . just remove cap. No need to disassemble the motor or remove it from line for switch repairs. Same switch fits all sizes of motors . . . 1 to 5 HP.

You get real economy where dust, fumes or moisture are a problem. Dealers everywhere. Send for literature.

*"World's Most Respected Motor"*

**BROOK MOTOR CORPORATION**

3302-04 W. PETERSON AVE., CHICAGO 45, ILL.

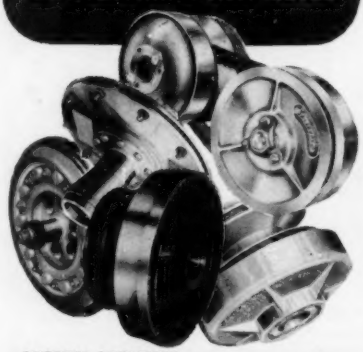
IN CANADA: BROOK ELECTRIC MOTORS OF CANADA, LTD., 250 UNIVERSITY AVENUE, TORONTO

SINCE 1904

BROOK ELECTRIC MOTORS

Circle No. 67 on Reader Service Card

AUTOMATIC CLUTCHES AND TRANSMISSIONS FOR EVERYTHING THAT MOVES



**CUSTOM DESIGNED** to rigid specifications; engineered and operation-tested to meet the highest performance standards; then mass produced to match production schedules. 24 years experience supplying special design clutches and transmissions to manufacturers of scooters, golf carts, industrial equipment, helicopters . . . almost anything that moves. Write for information on Salsbury clutch and transmission engineering service from "product design to assembly line."

SALSBURY CORPORATION

1161 E. FLORENCE AVE., LOS ANGELES 1, CAL.

Circle No. 45 on Reader Service Card

# Facts At Your Fingertips

**If you want details about products described or advertised in this issue, circle the number on the card that corresponds with the number under each advertisement or product description.**

**POWER TRANSMISSION DESIGN**

**October 1960,** Circle item numbers for additional information about products described and advertised in this issue.

**ADVERTISEMENTS**

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 13 | 25 | 37 | 49 | 61 | 73 | 85 | 97 | 109 | 121 | 133 | 145 |
| 2 | 14 | 26 | 38 | 50 | 62 | 74 | 86 | 98 | 110 | 122 | 134 | 146 |
| 3 | 15 | 27 | 39 | 51 | 63 | 75 | 87 | 99 | 111 | 123 | 135 | 147 |
| 4 | 16 | 28 | 40 | 52 | 64 | 76 | 88 | 100 | 112 | 124 | 136 | 148 |
| 5 | 17 | 29 | 41 | 53 | 65 | 77 | 89 | 101 | 113 | 125 | 137 | 149 |
| 6 | 18 | 30 | 42 | 54 | 66 | 78 | 90 | 102 | 114 | 126 | 138 | 150 |
| 7 | 19 | 31 | 43 | 55 | 67 | 79 | 91 | 103 | 115 | 127 | 139 | 151 |
| 8 | 20 | 32 | 44 | 56 | 68 | 80 | 92 | 104 | 116 | 128 | 140 | 152 |
| 9 | 21 | 33 | 45 | 57 | 69 | 81 | 93 | 105 | 117 | 129 | 141 | 153 |
| 10 | 22 | 34 | 46 | 58 | 70 | 82 | 94 | 106 | 118 | 130 | 142 | 154 |
| 11 | 23 | 35 | 47 | 59 | 71 | 83 | 95 | 107 | 119 | 131 | 143 | 155 |
| 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 |

**Card Invalid Without Company Name — Type or Print**

NAME _____

TITLE _____

COMPANY _____

PRODUCT MFG. _____

ADDRESS _____

CITY _____ ZONE _____

STATE _____

Do not use after Jan. 15, 1961

**NEW PRODUCTS**

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 200 | 206 | 212 | 218 | 224 | 230 | 236 | 242 | 248 | 254 | 260 | 266 |
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**FREE LITERATURE**

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
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| 304 | 310 | 316 | 322 | 328 | 334 | 340 | 346 | 352 |
| 305 | 311 | 317 | 323 | 329 | 335 | 341 | 347 | 353 |

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**ADVERTISEMENTS**

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| 2 | 14 | 26 | 38 | 50 | 62 | 74 | 86 | 98 | 110 | 122 | 134 | 146 |
| 3 | 15 | 27 | 39 | 51 | 63 | 75 | 87 | 99 | 111 | 123 | 135 | 147 |
| 4 | 16 | 28 | 40 | 52 | 64 | 76 | 88 | 100 | 112 | 124 | 136 | 148 |
| 5 | 17 | 29 | 41 | 53 | 65 | 77 | 89 | 101 | 113 | 125 | 137 | 149 |
| 6 | 18 | 30 | 42 | 54 | 66 | 78 | 90 | 102 | 114 | 126 | 138 | 150 |
| 7 | 19 | 31 | 43 | 55 | 67 | 79 | 91 | 103 | 115 | 127 | 139 | 151 |
| 8 | 20 | 32 | 44 | 56 | 68 | 80 | 92 | 104 | 116 | 128 | 140 | 152 |
| 9 | 21 | 33 | 45 | 57 | 69 | 81 | 93 | 105 | 117 | 129 | 141 | 153 |
| 10 | 22 | 34 | 46 | 58 | 70 | 82 | 94 | 106 | 118 | 130 | 142 | 154 |
| 11 | 23 | 35 | 47 | 59 | 71 | 83 | 95 | 107 | 119 | 131 | 143 | 155 |
| 12 | 24 | 36 | 48 | 60 | 72 | 84 | 96 | 108 | 120 | 132 | 144 | 156 |

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| 204 | 210 | 216 | 222 | 228 | 234 | 240 | 246 | 252 | 258 | 264 | 270 |
| 205 | 211 | 217 | 223 | 229 | 235 | 241 | 247 | 253 | 259 | 265 | 271 |

**FREE LITERATURE**

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**These cards are your tickets to this prompt service. Use them to secure details about any item in this issue that has a key number. For instance:**

**ADVERTISEMENTS — a showcase of the latest in components, equipment & techniques.**

**NEW PRODUCTS — brief descriptions of significant new products and materials.**

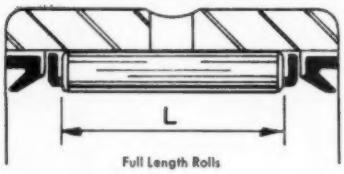
**PRODUCT APPLICATIONS — brief reports on successful applications of recently developed products and materials.**

**NEW LITERATURE — offerings of new catalogs, data books, price lists, and other valuable reference material.**

# More Load Capacity! More Design Flexibility!

## ORANGE SEALED *Cage Type* NEEDLE BEARINGS

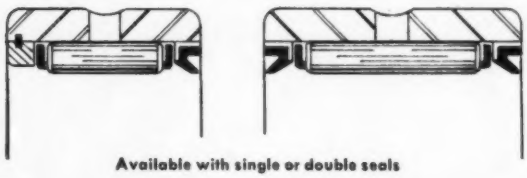
### Longer Rolls—Higher Capacity




Full Length Rolls

Only Orange construction provides effective sealing without reducing roll length or load carrying capacity. Note the proportion of roll length to race, compared with other types. You get the full load capacity of Orange Cage Type Needle Bearings—plus the economy and efficiency of built-in Neoprene seals to keep dirt out and lubricant in.

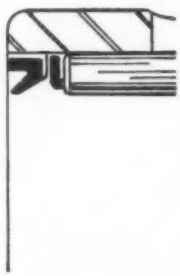
### TWO Bearing Lengths for Design Flexibility



Available with single or double seals

Only Orange offers Sealed Cage Type Needle Bearings in TWO bearing lengths for each shaft diameter. Both bearing lengths have full-length rolls in proper proportion to race, providing maximum load-carrying capacity. Thus, you have greater flexibility in meeting load, space and design requirements. Other sealed needle bearings offer only one bearing length, with shorter rolls and less capacity.

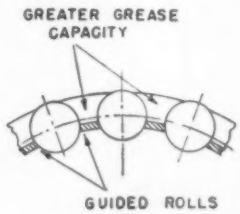
### Effective Seal Design →



This provides positive exclusion of foreign matter, retains lubricant and acts as a vent to prevent displacement of seal if additional lubrication is added through holes provided in races.

### —plus advantages of Orange Cage Design

The Orange cage design assures constant contact with entire length of roll periphery to provide the ultimate in guided rolls and resistance to skewing. Adequate space around rolls provides exceptional capacity for lubrication.




●

**Stocked in popular sizes from ½" to 4" shaft diameters. Other sizes will be added as volume requirements are established.**

**Write for new, detailed brochure giving engineering data, construction, dimensions, etc.**

**ORANGE ROLLER BEARINGS**

**ORANGE ROLLER BEARING CO., Inc.**
**552 Main Street, Orange, N. J.**

**Needle Bearings—Staggered Roller Bearings**
**Journal Roller Bearings—Thrust Roller Bearings**
**Cam Followers**

**Circle No. 40 on Reader Service Card**

# HELP YOURSELF....

## to more information

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